

# Exhibit 3

IN THE UNITED STATES DISTRICT COURT  
FOR THE SOUTHERN DISTRICT OF WEST VIRGINIA

IN RE NATIONAL  
PRESCRIPTION OPIATE  
LITIGATION  
**Cabell County Commission  
and City of Huntington, WV**

: CIVIL ACTION NO.  
: 3:17-01362  
:  
: and  
:  
: CIVIL ACTION NO.  
: 3:17-01665

EXPERT REPORT OF CRAIG J. MCCANN, PH.D., CFA

August 3, 2020

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## **I. Qualifications and Remuneration**

### **A. Qualifications**

1. I am the President of Securities Litigation and Consulting Group, Inc. (“SLCG”). SLCG was founded in 2000 to apply finance, economics, statistics and mathematics in litigation and consulting. SLCG staff includes professionals with PhDs and advanced degrees in applied mathematics, statistics, finance and economics.

2. Prior to founding SLCG, I was a Director at LECG, a business unit of Navigant Consulting, Inc. Prior to joining LECG, I was Managing Director, Securities Litigation at KPMG LLP for two years. I was a senior financial economist in the Office of Economic Analysis at the U.S. Securities and Exchange Commission (the “SEC”) from 1992 to 1993 and from 1994 to 1995.

3. I have taught graduate economics and finance courses at the University of South Carolina, Virginia Tech, Georgetown University and at the University of Maryland, College Park.

4. I have been hired as a consultant and expert witness in investigations by many state and federal agencies including the SEC, the Federal Deposit Insurance Corporation and the U.S. Department of Justice.

5. My work as a consultant and expert witness over the past 25 years has required me to extract or receive data, process and validate the data and produce varied statistical analyses.

6. I earned a Ph.D. in Economics from the University of California, at Los Angeles. My graduate studies included extensive coursework in mathematics, statistics and econometrics.

7. My resume, which includes a list of all publications authored by me within the last 10 years and the cases in which I have testified as an expert at trial or by deposition within the last four years, is attached as Appendix 1.

8. I previously provided expert testimony on substantially the same issues discussed below through written reports and depositions in *In Re National Prescription Opiate Litigation* and *In Re Opioid Litigation* more fully identified in my resume.

### **B. Remuneration**

9. SLCG is being compensated for its time and expenses. My hourly rate is \$475 per hour. Other SLCG personnel working on this matter have billing rates of \$100 to \$350 per hour.

### **II. Materials Considered**

10. In preparing this report, I have considered the following documents:

- a. Automation of Reports and Consolidated Orders System (“ARCOS”) electronic data, received from the Drug Enforcement Administration (hereafter, “ARCOS Data”);
- b. “ARCOS Retail Drug Summary Reports,” Drug Enforcement Administration, 2000-2019, (available at [www.deadiversion.usdoj.gov/arcos/retail\\_drug\\_summary/index.html](http://www.deadiversion.usdoj.gov/arcos/retail_drug_summary/index.html));

- c. “National Drug Code Dictionary,” Drug Enforcement Administration, November 2018 (current version available at [www.deadiversion.usdoj.gov/arcos/ndc/ndcfile.txt](http://www.deadiversion.usdoj.gov/arcos/ndc/ndcfile.txt));
- d. “NDC Dictionary Instructions,” Drug Enforcement Administration, October 2010 (current version available at [www.deadiversion.usdoj.gov/arcos/ndc/readme.txt](http://www.deadiversion.usdoj.gov/arcos/ndc/readme.txt));
- e. “NDC/NHRIC Labeler Codes,” U.S. Food & Drug Administration, January 2018 (current version available at [www.fda.gov/ForIndustry/DataStandards/StructuredProductLabeling/ucm191017.htm](http://www.fda.gov/ForIndustry/DataStandards/StructuredProductLabeling/ucm191017.htm));
- f. “Opioid Oral Morphine Milligram Equivalent (MME) Conversion Factors,” Centers for Disease Control and Prevention, August 2017 (current version available at [www.cdc.gov/drugoverdose/resources/data.html](http://www.cdc.gov/drugoverdose/resources/data.html));
- g. “Full Replacement Monthly NPI File,” Centers for Medicare and Medicaid Services, November 2018 (current version available at [download.cms.gov/nppes/NPI\\_Files.html](http://download.cms.gov/nppes/NPI_Files.html));
- h. ARCOS Registrant Handbook, Drug Enforcement Administration, August 1997 (current version available at [www.deadiversion.usdoj.gov/arcos/handbook/full.pdf](http://www.deadiversion.usdoj.gov/arcos/handbook/full.pdf));
- i. Masters Pharmaceutical, Inc. v. Drug Enforcement Administration, 861 F.3d 206 (D.C. Cir. 2017);
- j. U.S. Dep't of Justice, DEA, Chemical Handler's Manual: A Guide to Chemical Control Regulations (2004), (WAGMDL00395965);

- k. U.S. Dep’t of Justice, DEA, *Diversion Investigators Manual* (1990) (CAH\_MDL\_PRIORPROD\_DEA07\_01176247);
- l. U.S. Dep’t of Justice, DEA, *Diversion Investigators Manual* (1996) (CAH\_MDL2804\_02203353);
- m. Administrative Memorandum of Agreement (between DEA and Mallinckrodt);<sup>1</sup>
- n. “Red Flags and Warning Signs Ignored: Opioid Distribution and Enforcement Concerns in West Virginia,” Prepared by the Energy and Commerce Committee, Majority Staff, December 19, 2018, (US-DEA-00025303 – 00025627);
- o. Defendants’ Transactional Data in West Virginia (ABDCMDL00003913; ABDCMDL01911435 - ABDCMDL01911478; ABDC-WVFED00000001 - ABDC-WVFED00000009; CAH\_MDL2804\_03468426 - CAH\_MDL2804\_03468433; MCKMDL01391022 - MCKMDL01391081; MCKMDL01391082 - MCKMDL01391096; MCKMDL01391099 - MCKMDL01391111; MCKMDL01391112 - MCKMDL01391126);
- p. Drug Emporium dispensing data (DE0034480- DE0034486);

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<sup>1</sup> [www.justice.gov/usao-edmi/press-release/file/986026/download](http://www.justice.gov/usao-edmi/press-release/file/986026/download)

- q. Suspicious Order Reports produced by the DEA  
(DEA\_000000001(confidential\_suspicious\_trans\_oh\_wv\_al\_il\_mi \_fl\_20060101-20141231.xlsx); SORS-000001 - SORS-2932);
- r. Suspicious Order Reports produced by AmerisourceBergen Drug, Cardinal Health and McKesson Corporation  
(ABDCMDL01911479; ABDCMDL01911482;  
ABDCMDL00003913; CAH\_MDL2804\_03468434;  
CAH\_FEDWV\_00377023-CAH\_FEDWV\_00377825;  
CAH\_MDL\_PRIORPROD\_DEA07\_01544958;  
CAH\_MDL\_PRIORPROD\_DEA07\_01641502;  
CAH\_MDL\_PRIORPROD\_DEA07\_01190057;  
CAH\_MDL2804\_00689780; CAH\_MDL2804\_00718279;  
CAH\_MDL2804\_00613605; CAH\_MDL2804\_00719378;  
CAH\_MDL\_PRIORPROD\_DEA07\_01120515;  
CAH\_MDL\_PRIORPROD\_DEA07\_02731023-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01544958-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01641502-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01649530-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01658177-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01667412-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01679058-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01698986-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01708184-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01718249-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01731023-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01738760-R;

CAH\_MDL\_PRIORPROD\_DEA07\_01746932-R;  
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CAH\_MDL\_PRIORPROD\_DEA07\_01761369-R;  
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CAH\_MDL\_PRIORPROD\_DEA07\_01803669-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01810924-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01815068-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01820263-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01829063-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01833389-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01837849-R;  
CAH\_MDL\_PRIORPROD\_DEA07\_01845055-R;  
CAH\_MDL2804\_03060159; CAH\_MDL2804\_03060627;  
CAH\_MDL2804\_01909637; CAH\_MDL2804\_01909938;  
CAH\_MDL2804\_01212458; CAH\_MDL2804\_01212460;  
CAH\_MDL2804\_01212684; CAH\_MDL2804\_01212686;  
CAH\_MDL2804\_01214790; CAH\_MDL2804\_01214792;  
CAH\_MDL2804\_01215078; CAH\_MDL2804\_01215080;  
CAH\_MDL2804\_01215082; CAH\_MDL2804\_01215084;  
CAH\_MDL2804\_01215394; CAH\_MDL2804\_01215638;

CAH\_MDL2804\_01215640; CAH\_MDL2804\_01215642;  
CAH\_MDL2804\_01215644; CAH\_MDL2804\_01216962;  
CAH\_MDL2804\_01217648; CAH\_MDL2804\_01218306;  
CAH\_MDL2804\_01218622; CAH\_MDL2804\_01218624;  
CAH\_MDL2804\_01218626; CAH\_MDL2804\_01222854;  
CAH\_MDL2804\_01222856; CAH\_MDL2804\_01222858;  
CAH\_MDL2804\_01223654; CAH\_MDL2804\_01223656;  
CAH\_MDL2804\_01223658; CAH\_MDL2804\_01226130;  
CAH\_MDL2804\_01226132; CAH\_MDL2804\_01226138;  
CAH\_MDL2804\_01226146; CAH\_MDL2804\_01226148;  
CAH\_MDL2804\_01226150; CAH\_MDL2804\_01226166;  
CAH\_MDL2804\_01226168; CAH\_FEDWV\_00377023 -  
CAH\_FEDWV\_00377825; MCKMDL01391127).

- s. Deposition of Thomas Prevoznik, April 17-18, 2019, May 17, 2019 and exhibits thereto;
- t. Corrected Joint and Third Amended Complaint, Cabell County Commission and City of Huntington, West Virginia;
- u. Discovery Ruling No. 12 Regarding Suspicious Order Interrogatory [Doc. 1174];
- v. Cardinal Health DEA Compliance Manual  
(CAH\_MDL\_PRIORPROD\_DEA07\_01383895);
- w. McKesson Operations Manual Lifestyle Drug Monitoring Program  
(MCKMDL00355251);
- x. Other documents cited in the text and footnotes below.

### **III. Assignment**

11. I have been asked by Plaintiffs' Counsel to document how I processed, validated and augmented opioid transaction data produced by the Drug Enforcement Administration ("DEA") and internal Transactional Data (identified in paragraph "10.o" above) produced by the Distributor Defendants, to attribute transactions with Dispensers to Distributor Defendants in this report.<sup>2</sup>

12. I have been asked to summarize shipments in the ARCOS Data, especially those shipments into Cabell County and the City of Huntington, WV attributable to all the Defendants.

13. I have also been asked to report the results of applying certain algorithms to the ARCOS Data and Distributor Defendants' Transactional Data.

### **IV. Summary of Opinions**

14. Based upon my comparison of the ARCOS Data produced by the DEA and the public ARCOS Retail Drug Summary Reports, I conclude that, after correcting a relatively small number of records records as explained in more detail below, the ARCOS Data produced by the DEA is reliable.

15. I conclude that the ARCOS Data is reliable in part because it closely matches the DEA's Retail Drug Summary Reports for January 2006 through December 2014. Retail Drug Summary Reports summarize the weight of drugs in reported transactions with consumers in each of the 50

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<sup>2</sup> As explained more fully below I use "Dispensers" to refer to businesses that dispense drugs to patients such as pharmacies and hospitals.

states and the District of Columbia. Where there were discrepancies between the ARCOS Data produced by the DEA and the Retail Drug Summary Reports, I was able to identify and correct the error in either the ARCOS Data or the Retail Drug Summary Reports.

16. In Section V, I describe the ARCOS Data produced by the DEA and report national summary statistics for the ARCOS Data, after correcting minimal errors explained fully in Appendix 2. In addition, I compare the processed ARCOS Data to Retail Drug Summary Reports published by the DEA to verify that the shipments of opioids to dispensing outlets in the ARCOS Data are consistent with the amount of each opioid the DEA calculates was shipped into each 3-digit zip code each quarter.

17. In Section VI, I report summary statistics for subsets of the processed ARCOS Data covering Cabell County and the City of Huntington, WV. These summary statistics show that between 2006 and 2014, Dispensers in Cabell County and the City of Huntington, WV received 127.9 million Dosage Units or 3.3 billion MME of opioids. Given the region's 99,946 average population during this same time period,<sup>3</sup> Dispensers received enough opioids for every resident in Cabell County and the City of Huntington, WV to consume 142 Dosage Units or 3,650 MME every year from 2006 to 2014.

18. In Section VII, I describe a non-exhaustive set of algorithms that can be systematically applied to the ARCOS Data, supplemented with Defendants' Transactional Data.

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<sup>3</sup> United States Census Bureau, <https://www.census.gov/>

19. In Section VIII, I describe certain charts and tables that are attached to this report. In Section IX, I summarize my conclusions.

20. I continue to review documents and gather information and reserve the right to update my analysis and opinions based upon that further review of documents and based on any new information including, possibly, reports of other experts I may receive.

## V. National ARCOS Data

21. ARCOS is the system through which manufacturers and distributors report transactions of controlled substances to the DEA.<sup>4</sup> ARCOS Data covers all fifty states, the District of Columbia, Puerto Rico, Guam, U.S. Virgin Islands, American Samoa, and the Northern Mariana Islands, Armed Forces-Americas, Armed Forces-EMEA, Armed Forces-Pacific, and Palau.

### A. Receipt of ARCOS Data from the DEA

22. In the multi-district litigation, the DEA produced a set of ARCOS Data reflecting transactions in drug products containing one or more of fourteen drugs: buprenorphine, codeine, dihydrocodeine, fentanyl, hydrocodone, hydromorphone, levorphanol, meperidine, methadone, morphine, powdered opium, oxycodone, oxymorphone, and tapentadol from January 1, 2006 through December 31, 2014.

23. On or about April 20, 2018, the DEA produced ARCOS Data reflecting transactions in oxycodone, hydrocodone, hydromorphone, and fentanyl for six states: Alabama, Florida, Illinois, Michigan, Ohio, and West

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<sup>4</sup> [www.deadiversion.usdoj.gov/arcos/index.html](http://www.deadiversion.usdoj.gov/arcos/index.html), accessed on 29 November 2018.

Virginia. On or about May 20, 2018, the DEA produced transaction data for these four drugs for the remaining states. The May 20, 2018 production was missing pharmacy names and had some duplicate transactions and obvious errors. At my request, the DEA reproduced the May 20, 2018 data with pharmacy names and errors in the May 20, 2018 production largely corrected on or about June 5, 2018.

24. Additionally, the DEA produced ARCOS Data for all states for oxymorphone, tapentadol, buprenorphine, and morphine on or about July 6, 2018; for codeine, dihydrocodeine, meperidine, and powdered opium on or about July 24, 2018; and for methadone and levorphanol on or about August 28, 2018. The timing and amount of ARCOS Data produced by the DEA are summarized in Table 1. In total, the ARCOS Data has 500,709,803 transaction records – 444,819,182 transaction records involving Dispensers.

**Table 1 ARCOS Opioid Transaction Data Produced by DEA**

<b>Drug Name</b>	<b>Drug Code</b>	# of All Transactions	# of Transactions	<b>Transactions with Dispensers</b>		
				Dosage Units	Dosage Units %	Calculated Base Weight
<b>Received June 5, 2018</b>						
Hydrocodone	9193	189,611,242	174,829,777	74,285,510,348	53.04%	436,729,519
Oxycodone	9143	116,411,941	106,210,465	39,978,942,635	28.54%	494,278,594
Fentanyl	9801	51,159,276	42,971,667	914,488,221	0.65%	8,096,158
Hydromorphone	9150	17,446,169	14,435,387	2,571,523,184	1.84%	15,161,478
<b>Subtotal</b>		<b>374,628,628</b>	<b>338,447,296</b>	<b>117,750,464,388</b>	<b>84.07%</b>	<b>954,265,749</b>
<b>Received July 6, 2018</b>						
Morphine	9300	49,243,546	39,880,848	6,365,919,333	4.55%	222,022,285
Buprenorphine	9064	26,275,507	24,153,401	1,857,399,214	1.33%	152,570,080
Oxymorphone	9652	6,033,613	5,008,054	633,293,763	0.45%	11,042,968
Tapentadol	9780	3,376,288	2,827,854	353,918,908	0.25%	28,776,260
<b>Subtotal</b>		<b>84,928,954</b>	<b>71,870,157</b>	<b>9,210,531,218</b>	<b>6.58%</b>	<b>414,411,593</b>
<b>Received July 24, 2018</b>						
Codeine	9050	17,644,740	14,728,585	5,904,595,163	4.22%	149,048,894
Meperidine	9230	6,069,787	4,439,671	296,424,349	0.21%	25,276,542
Dihydrocodeine	9120	1,150,066	762,778	47,182,023	0.03%	1,051,401
Opium, Powdered	9639	509,879	335,515	8,000,328	0.01%	383,634
<b>Subtotal</b>		<b>25,374,472</b>	<b>20,266,549</b>	<b>6,256,201,863</b>	<b>4.47%</b>	<b>175,760,471</b>
<b>Received August 28, 2018</b>						
Methadone	9250	15,668,247	14,167,720	6,829,158,005	4.88%	145,228,224
Levorphanol	9220	109,502	67,460	14,402,593	0.01%	18,947
<b>Subtotal</b>		<b>15,777,749</b>	<b>14,235,180</b>	<b>6,843,560,598</b>	<b>4.89%</b>	<b>145,247,171</b>
<b>Total</b>		<b>500,709,803</b>	<b>444,819,182</b>	<b>140,060,758,067</b>	<b>100.00%</b>	<b>1,689,684,984</b>
						<b>100.00%</b>

## B. ARCOS Data Fields Produced by DEA

25. The ARCOS Data produced by the DEA has the 34 fields illustrated in Figure 1 for each transaction record. Twelve of the 34 fields are submitted with each transaction record by the Reporting Registrant, the DEA registered entity reporting the opioid shipment through ARCOS. These twelve fields are defined in the ARCOS Handbook.<sup>5</sup> The remaining 22 fields were appended by the DEA to the transaction records submitted by the Reporting Registrant.<sup>6</sup> Eighteen of the 22 fields are information about the Reporting Registrant and the Associate Registrant, keyed off their DEA numbers.<sup>7</sup> Three of the remaining four fields are either taken from the NDC (for National Drug Code) Dictionary or are calculated using variables therein and appear to have been imported by the DEA into the data it produced by matching each transaction's NDC number with the NDC number in the NDC Dictionary.<sup>8</sup>

Figure 1 ARCOS Data Fields Produced by DEA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
<b>Reporter / Seller Info</b>										<b>Buyer Info</b>										<b>Transaction Info</b>													
Reporter Name DEA #	Reporter Address1 Address2	Buyer Name Name	County County	Zip Zip	State State	City City	Address1 Address1	Address2 Address2	Addl Co Info Addl Co Info	Action Indicator Action Indicator	Quantity Quantity	Drug Name Drug Name	NDC Number Drug Code	Transaction Code Transaction Code	Transaction Id Dosage Unit Calc Base Weight Grams Transaction Date Strength Correction Number Order Form Number																		

<sup>5</sup> “ARCOS Registrant Handbook,” Drug Enforcement Administration, August 1997 (“ARCOS Handbook”). Current version available at [www.deadiversion.usdoj.gov/arcos/handbook/full.pdf](http://www.deadiversion.usdoj.gov/arcos/handbook/full.pdf).

<sup>6</sup> The 22 fields are Reporter Business Activity, Reporter Name (2 fields), Reporter Address (6 fields), Buyer Business Activity, Buyer Name (2 fields), and Buyer Address (6 fields), Drug Code, Drug Name, Calculated Base Weight in Grams, and Dosage Unit.

<sup>7</sup> The 18 fields are Reporter Business Activity, Reporter Name (2 fields), Reporter Address (6 fields), Buyer Business Activity, Buyer Name (2 fields), and Buyer Address (6 fields).

<sup>8</sup> Drug Code and Drug Name are both in the NDC Dictionary. Calculated Base Weight in Grams is calculated using Ingredient Base Weight in the NDC Dictionary and Quantity, Unit, and Strength in the ARCOS Data.

26. The first 10 fields provide information on the Reporting Registrant. The DEA identified these Reporter DEA numbers and associated fields as “Seller” fields and so, unless the context requires otherwise, I refer to the Reporting Registrant as the “Seller” and the associated fields as “Seller” fields. This information includes a Seller’s DEA Number, a description of the Seller’s Business Activity (primarily Manufacturer, Distributor or Reverse Distributor), Name and Address (6 fields).

27. The next 10 fields provide information on the Associate Registrant, typically a receiver of the opioid shipment.<sup>9</sup> The DEA identified the Associate Registrant DEA numbers and associated fields as “Buyer” fields and so, unless the context requires otherwise, I refer to the Associate Registrant as the “Buyer” and the associated fields as “Buyer” fields. This information includes the Buyer’s DEA Number, a description of the Buyer’s Business Activity (primarily Distributor or Retail or Chain Pharmacy), Name and Address (6 fields).

28. The final 14 fields provide information about the transaction. This information includes Drug Name and Drug Code (*e.g.*, 9143 for oxycodone products), NDC Number, Quantity, Unit, Strength, Dosage Unit, Calculated Base Weight in Grams, Transaction Code (*e.g.*, whether the transaction was a Purchase or a Sale), Transaction Date, Transaction Identifier, Correction Number, Action Indicator, and Order Form Number.

*1. Seller DEA Number*

29. The ARCOS Data produced by the DEA includes 1,506 distinct Seller DEA Numbers. Manufacturers and distributors typically have more

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<sup>9</sup> See, ARCOS Handbook at pp. 5-36 – 5-37.

than one DEA number as each facility manufacturing or distributing controlled substances must have its own DEA number.<sup>10</sup>

*2. Seller Business Activity*

30. The ARCOS Data lists one “Business Activity” for each Seller DEA Number. There are six distinct Seller Business Activities in the ARCOS Data: Manufacturer, Manufacturer (Bulk), Chemical Manufacturer, Distributor, Chempack/SNS Distributor, and Reverse Distributor.

*3. Seller Name and Address*

31. The ARCOS Data provides a business address for each Seller DEA Number, but there is not a one-to-one mapping between the addresses and the Seller DEA Numbers. Some Seller DEA Numbers are associated with multiple addresses, and some addresses are associated with more than one contemporaneous Seller DEA Number. Multiple Seller DEA Numbers can also be associated with the same address over time as locations are occupied by businesses newly registered with the DEA.

*4. Buyer DEA Number*

32. The ARCOS Data includes 304,785 distinct Buyer DEA Numbers. 1,465 DEA numbers are listed as both Sellers and Buyers, although not in the same transaction.

*5. Buyer Business Activity*

33. The ARCOS Data includes 54 distinct Buyer Business Activities including Manufacturer, Distributor, Reverse Distributor, Analytical Lab, Retail Pharmacy, Chain Pharmacy, Mail Order Pharmacy and Hospital/Clinic. Some Buyer DEA Numbers have more than one Buyer Business Activity.

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<sup>10</sup> See, ARCOS Handbook at 1-5.

6. *Buyer Name and Address*

34. The ARCOS Data provides a business address for each Buyer DEA Number, but there is not a one-to-one mapping between the addresses and the Buyer DEA Numbers. Some Buyer DEA Numbers are associated with multiple addresses, and some addresses are associated with more than one contemporaneous Buyer DEA Number. Multiple Buyer DEA Numbers can also be associated with the same address over time as locations are occupied by businesses newly registered with the DEA.

7. *Transaction Codes*

35. Each transaction record includes a code that identifies whether the transaction being reported increases or decreases the Reporter's inventory of the drug. In my later analysis, I focus on transaction code "S" which denotes a transaction in which a drug is shipped from the Seller, typically a distributor, to a Buyer, typically a pharmacy. Appendix 3 reports the percentage of transactions in the ARCOS Data in each Transaction Code and provides the ARCOS Handbook description.<sup>11</sup>

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<sup>11</sup> ARCOS Handbook §5.4.3, p. 5-7.

*8. Drug Code and Drug Name*

36. The Drug Code is a four digit Administration Controlled Substance Code Number common to each controlled substance or basic class thereof.<sup>12</sup> For instance, whether delivered through skin patches or nasal sprays, fentanyl transactions are identified by the Drug Code 9801 and whether formed in 5 mg or 20 mg tablets, oxycodone transactions are identified with the Drug Code 9143. See Table 2.

**Table 2 Drug Codes and Drug Names in the ARCOS Data**

Sorted by Drug Name		Sorted by Drug Code	
Drug Code	Drug Name	Drug Code	Drug Name
9064	Buprenorphine	9050	Codeine
9050	Codeine	9064	Buprenorphine
9120	Dihydrocodeine	9120	Dihydrocodeine
9801	Fentanyl	9143	Oxycodone
9193	Hydrocodone	9150	Hydromorphone
9150	Hydromorphone	9193	Hydrocodone
9220	Levorphanol	9220	Levorphanol
9230	Meperidine	9230	Meperidine
9250	Methadone	9250	Methadone
9300	Morphine	9300	Morphine
9639	Opium	9639	Opium
9143	Oxycodone	9652	Oxymorphone
9652	Oxymorphone	9780	Tapentadol
9780	Tapentadol	9801	Fentanyl

*9. National Drug Code*

37. Drug packages are uniquely identified in the ARCOS Data by a National Drug Code, or NDC. The NDC has three segments, which identify the drug product's manufacturer or distributor, active ingredient, strength and formulation of the product, and the package size.<sup>13</sup> For example, 00603-3882-

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<sup>12</sup> See, Controlled Substances by DEA Drug Code Number, Current version available at [https://www.deadiversion.usdoj.gov/schedules/orangebook/d\\_cs\\_drugcode.pdf](https://www.deadiversion.usdoj.gov/schedules/orangebook/d_cs_drugcode.pdf); see also, 21 CFR 1308.03.

<sup>13</sup> “NDC Dictionary Instructions,” Drug Enforcement Administration, October 2010. Current version available at <https://www.deadiversion.usdoj.gov/arcos/ndc/readme.txt>.

28 identifies Par Pharmaceutical manufactured 7.5 mg hydrocodone / 500 mg acetaminophen tablets in packages of 30. NDCs ending in “\*\*” identify bulk packages of the drug identified by the first 9 digits of the NDC.

38. There are 23,280 unique NDCs in the ARCOS Data. The controlled substances in each drug product are identified by a separate Drug Code.

*10. Quantity*

39. Quantity is the number of packages, weight or volume reported in the transaction.<sup>14</sup> A package can take many different forms, including a bottle of pills, a bottle of liquid, a box containing multiple bottles of drug product, a container of bulk drug powder, a box of skin patches, or a larger box containing smaller boxes of skin patches.<sup>15</sup>

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<sup>14</sup> ARCOS Handbook § 5.11.1 p., 5-30.

<sup>15</sup> ARCOS Handbook § 5.11.

*11. Unit*

40. The Unit code identifies the unit of measurement for the Quantity field. It is used with the Quantity and Strength fields to determine the amount of drug in a transaction.<sup>16</sup> The Unit codes 1, 2, 3 and 4 specify weight units from micrograms to kilograms.<sup>17</sup> See Table 3.

**Table 3 Unit of Measurement Codes**

<b>Unit</b>	<b>Measurement</b>
1	Micrograms
2	Milligrams
3	Grams
4	Kilograms
5	Milliliters
6	Liters
D	Dozens
K	Thousands

*12. Action Indicator*

41. The Action Indicator field is either blank or coded D (for delete), A (for adjust) or I (for insert). The Reporter uses transactions coded D to report to the DEA that a previously reported incorrect transaction should be deleted. The Reporter uses transactions coded A to report that a previously reported incorrect transaction should be revised to reflect updated information in the current record. That is, that the previously reported transaction should be replaced with the current transaction record coded A. The Reporter uses

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<sup>16</sup> ARCos Handbook § 5.12.1, p. 5-33.

<sup>17</sup> Since there are 1 billion micrograms in a kilogram, a transaction coded with a 4 in the Unit field when the Quantity field assumes the Units are micrograms will have a Quantity that is 1 billion times too large. Some of the errors in the ARCos Data appear to result from incorrect Unit codes being entered by the Reporting Registrant into ARCos.

transactions coded I to report transactions which should have been reported in a previous month but were not and so are being reported late.<sup>18</sup>

*13. Order Form Number*

42. The Order Form Number identifies a batch of one or more transactions submitted through ARCOS.<sup>19</sup>

*14. Correction Number*

43. The Correction Number identifies a correction transaction which replaces a previously submitted transaction that had been rejected by ARCOS.<sup>20</sup>

*15. Strength*

44. Strength reports the purity of bulk raw material in a transaction, relative to the purity of the NDC, in hundredths of a percentage point. Strength can also refer to the amount by which a quantity of one in the transaction falls short of or exceeds the standard size package of the NDC.<sup>21</sup>

*16. Transaction Date*

45. Transaction Date is the date a shipment occurred, not the date an order was placed by the Buyer or received by the Seller or the date of some other activity.<sup>22</sup>

*17. Calculated Base Weight in Grams*

46. The Calculated Base Weight in Grams is the total active ingredient weight, in grams, of a drug in the reported transaction. The

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<sup>18</sup> ARCOS Handbook §5.9.2, p. 5-20 and §7.5, p. 7-12.

<sup>19</sup> ARCOS Handbook §5.14.1, p. 5-38 and §5.14.3, p. 5-40.

<sup>20</sup> ARCOS Handbook, §5.16, p. 5-42.

<sup>21</sup> ARCOS Handbook, §5.17, p. 5-43.

<sup>22</sup> ARCOS Handbook, §5.15.1, p. 5-40.

Calculated Base Weight in Grams in the ARCOS Data produced by the DEA was not reported by the Sellers. Rather, it was calculated by the DEA and appended (along with information about the Buyer and the Seller, the Drug Code, the Drug Name, and the Dosage Units) by the DEA before the data was produced. As explained in Appendix 2, I verify the Calculated Base Weight in Grams for each transaction using the NDC Dictionary.

*18. Dosage Units*

47. Dosage Units is the number of packages in the transaction, multiplied by the number of discrete individual drug products (*e.g.*, pills, patches, lozenges) in each package. Dosage Unit is only populated if the drug product is delivered as a capsule, tablet, film, suppository, patch, lollipop, or lozenge. The Dosage Unit in the ARCOS Data was not reported by the Sellers. Rather, it was calculated by the DEA and appended by the DEA before the data was produced to us. As explained later in this report, I verify Dosage Units for each transaction using the NDC Dictionary.

*19. Transaction ID*

48. The Transaction ID uniquely identifies the transactions submitted by each Seller each month.<sup>23</sup> Each Seller restarts the Transaction ID each month at 1. For example, a Seller submitting 33, 41 and 17 transactions over a three-month period would submit transactions numbered 1 to 33 the first month, 1 to 41 the second month and 1 to 17 the third month. A later correction, adjustment or deletion should have the same Transaction ID as the record being corrected, adjusted or deleted. A late transaction uses the next available Transaction ID for the month in which the transaction

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<sup>23</sup> ARCOS Handbook, §5.18, pp. 5-46 through 5-47.

should have been reported, not a Transaction ID for the month in which the late transaction is being reported.

### **C. Supplementing the ARCOS Data**

49. I added several fields to the ARCOS Data to assist in my analysis. The fields are drug Labeler names from the FDA, drug Labeler company families, Seller company families, drug product potency information from the CDC’s Morphine Milligram Equivalents (MME) conversion table, and Buyer business activities from the Centers for Medicare and Medicaid Services.

#### *1. Drug Labeler*

50. The ARCOS Data includes the Seller name but not the Labeler name. As explained by the DEA, “A Labeler is any firm that manufacturers, distributes or repacks/relabels a drug product.”<sup>24</sup> The Labeler is identified in the first segment of the NDC. The FDA, which assigns the Labeler identifier used in the NDC, maintains a public list of Labeler identifiers and their associated companies. I used the FDA’s list of drug Labelers to add the names of the drug Labelers to the ARCOS Data.<sup>25</sup>

51. After adding Labeler names, I manually reviewed the names and grouped them into company families. For example, I assigned “Teva Pharmaceuticals USA, Inc.” and “Teva Parenteral Medicines, Inc.” to the same “Teva” company family.

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<sup>24</sup> [NDC Dictionary Instructions](#). See also, ARCOS Handbook, §6.1.2.1, p. 6-2.

<sup>25</sup> NDC/NHRIC Labeler Codes,” U.S. Food & Drug Administration. Available at [www.fda.gov/ForIndustry/DataStandards/StructuredProductLabeling/ucm191017.htm](http://www.fda.gov/ForIndustry/DataStandards/StructuredProductLabeling/ucm191017.htm).

2. *MME Conversion Factor*

52. Because each drug can be prescribed in more than one dosage strength (*e.g.*, 5 mg or 10 mg), compiling only the number of pills shipped provides a partial picture of the number of drugs shipped. Also, since different drugs can have different potencies, compiling only the total weight of active ingredient shipped also provides a partial picture of the number of drugs shipped.

53. The CDC has published “MME conversion factors” that allow opioids to be directly comparable to one another by converting different drugs and dosage strengths into morphine milligram equivalents.<sup>26</sup> I added the MME conversion factor to the ARCOS Data, matching the NDC in the CDC table to the NDC in the ARCOS Data.

3. *Additional Pharmacy Information*

54. I supplemented the Buyer Business Activity field with data from the Centers for Medicare and Medicaid Services, which assigns National Provider Identifiers (“NPIs”) to most covered health care providers in the United States. In addition to assigning and tracking NPIs, the Centers for Medicare and Medicaid Services provides a classification of Buyers’ Business Activities that is more detailed than the classification in the ARCOS Data, allowing me to better identify mail-order pharmacies, long-term care pharmacies, and managed care pharmacies. I used the Buyer Name and

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<sup>26</sup> National Center for Injury Prevention and Control. CDC compilation of benzodiazepines, muscle relaxants, stimulants, zolpidem, and opioid analgesics with oral morphine milligram equivalent conversion factors, 2018 version. Atlanta, GA: Centers for Disease Control and Prevention; 2018. Available at [www.cdc.gov/drugoverdose/resources/data.html](http://www.cdc.gov/drugoverdose/resources/data.html).

Address in the ARCOS Data to look up each Buyer in the NPI database.<sup>27</sup> I used the NPI database to identify mail-order, long-term care and managed care pharmacies, but I otherwise relied on the Buyer Business Activity in the ARCOS Data.

#### **D. Exclusions and Corrections to ARCOS Data**

55. The ARCOS Data is composed of transactions, or shipments, of opioids between various entities. Table 4 summarizes the number of transactions, the total Dosage Units, and the total Calculated Base Weight in Grams transacted between various types of entities as reflected in the ARCOS data I received.

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<sup>27</sup> NPI database.

**Table 4 ARCOS Transactions, Grouped by Transaction Participant**

	<b># of Transactions</b>	<b>%</b>	<b>Dosage Units</b>	<b>Dosage Units %</b>	<b>Calculated Base Weight</b>	<b>Calculated Weight %</b>
<b>Shipments to Dispensers</b>						
from Manufacturers	2,762,706	0.55%	1,963,746,971	0.18%	37,570,470	0.00%
from Distributors	422,984,879	84.48%	134,013,039,950	12.07%	1,444,335,948	0.13%
from Reverse Distributors	2,253	0.00%	687,343	0.00%	22,300	0.00%
Total to Dispensers	<b>425,749,838</b>	<b>85.03%</b>	<b>135,977,474,264</b>	<b>12.25%</b>	<b>1,481,928,717</b>	<b>0.13%</b>
<b>Shipments to Distributors</b>						
from Manufacturers	1,550,685	0.31%	291,953,694,524	26.30%	3,179,271,563	0.29%
from Distributors	24,798,146	4.95%	350,052,547,710	31.53%	3,606,767,355	0.33%
from Reverse Distributors	1,327,210	0.27%	107,448,095	0.01%	1,506,287	0.00%
from Dispensers	2,285,969	0.46%	632,110,738	0.06%	6,866,875	0.00%
from Analytical Labs	1,198	0.00%	43,046,052	0.00%	611,594	0.00%
from Other Buyers	40,128	0.01%	1,014,177,881	0.09%	8,865,834	0.00%
Total to Distributors	<b>30,003,336</b>	<b>5.99%</b>	<b>643,803,024,999</b>	<b>57.99%</b>	<b>6,803,889,509</b>	<b>0.62%</b>
<b>Shipments to Manufacturers</b>						
from Manufacturers	151,021	0.03%	97,475,133,509	8.78%	8,778,096,383	0.80%
from Distributors	226,226	0.05%	12,083,288,652	1.09%	94,142,768	0.01%
from Reverse Distributors	110,312	0.02%	2,392,297,817	0.22%	11,910,069	0.00%
from Dispensers	40,899	0.01%	1,875,916,549	0.17%	13,588,120	0.00%
from Analytical Labs	7,807	0.00%	223,368,384	0.02%	2,195,824	0.00%
from Other Buyers	3,045	0.00%	37,359,432	0.00%	66,828,227	0.01%
Total to Manufacturers	<b>539,310</b>	<b>0.11%</b>	<b>114,087,364,343</b>	<b>10.28%</b>	<b>8,966,761,391</b>	<b>0.81%</b>
<b>Shipments to Reverse Distributors</b>						
from Manufacturers	697,001	0.14%	105,770,466,624	9.53%	512,315,637,438	46.56%
from Distributors	1,669,040	0.33%	3,020,403,832	0.27%	42,645,345	0.00%
from Reverse Distributors	5,781,563	1.15%	469,806,226	0.04%	9,848,999	0.00%
from Dispensers	16,738,061	3.34%	1,562,427,349	0.14%	187,184,003	0.02%
from Analytical Labs	64,158	0.01%	127,606,571	0.01%	30,334,732,147	2.76%
from Other Buyers	16,643	0.00%	84,150,318	0.01%	270,182,657	0.02%
Total to Reverse Distributors	<b>24,966,466</b>	<b>4.99%</b>	<b>111,034,860,921</b>	<b>10.00%</b>	<b>543,160,230,589</b>	<b>49.36%</b>
<b>Shipments to Analytical Labs</b>						
from Manufacturers	167,272	0.03%	745,098,504	0.07%	215,457,334	0.02%
from Distributors	14,228	0.00%	115,326,842	0.01%	2,420,568	0.00%
from Reverse Distributors	19,195,712	3.83%	102,987,574,384	9.28%	539,621,113,047	49.04%
Total to Analytical Labs	<b>19,377,212</b>	<b>3.87%</b>	<b>103,847,999,730</b>	<b>9.35%</b>	<b>539,838,990,949</b>	<b>49.06%</b>
<b>Shipments to Other Buyers</b>						
from Manufacturers	20,501	0.00%	658,932,070	0.06%	80,325,531	0.01%
from Distributors	38,625	0.01%	697,580,301	0.06%	10,941,320	0.00%
from Reverse Distributors	8,938	0.00%	1,181,695	0.00%	36,084	0.00%
Total to Other Buyers	<b>68,064</b>	<b>0.01%</b>	<b>1,357,694,066</b>	<b>0.12%</b>	<b>91,302,935</b>	<b>0.01%</b>
<b>Shipments Lost in Transit</b>						
from Manufacturers	106	0.00%	7,191,204	0.00%	94,303	0.00%
from Distributors	4,809	0.00%	89,721,403	0.01%	572,751	0.00%
from Reverse Distributors	662	0.00%	55,064	0.00%	1,071	0.00%
Total Lost in Transit	<b>5,577</b>	<b>0.00%</b>	<b>96,967,670</b>	<b>0.01%</b>	<b>668,125</b>	<b>0.00%</b>
<b>Total</b>	<b>500,709,803</b>	<b>100.00%</b>	<b>1,110,205,385,993</b>	<b>100.00%</b>	<b>1,100,343,772,214</b>	<b>100.00%</b>

56. 85.03% of transactions reported in the ARCOS Data involve shipments to Buyers whose Business Activity suggests they dispense drugs to

patients. I call these Buyers “Dispensers.”<sup>28</sup> 3.8% of transactions involve shipments from Dispensers back to manufacturers or distributors.<sup>29</sup> 5.99% of transactions reported in the ARCOS Data involve shipments to Distributors. The number of transactions from Manufacturers to Distributors is small relative to the number of transactions from Distributors to Distributors but the Dosage Units and Calculated Based Weight in Grams is similar.

57. Table 4 is not entirely informative of the actual flow of opioids because some transactions reported by Reverse Distributors (“from Manufacturers” and “to Analytical Labs”) have incorrect Dosage Units and Calculated Base Weights in Grams. I do not use these Reverse Distributor transactions in the analysis I present below.

58. Only 0.03% of transactions are shipments to or from importers, exporters, or researchers (“Other Buyers”).<sup>30</sup>

59. I removed seven types of transactions from the ARCOS Data before conducting further analysis:

- Obvious duplicate transactions, when the same transaction was reported to ARCOS more than once by the same registrant.

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<sup>28</sup> I include the following Buyer Business Activities as Dispensers: any Buyer Business Activity beginning with “MLP”; any Buyer Business Activity containing “PHARMACY”, “PRACTITIONER”, “CLINIC”, “MAINT” or “DETOX”; and “AUTOMATED DISPENSING SYSTEM”, “CANINE HANDLER”, and “TEACHING INSTITUTION.”

<sup>29</sup> I include the following Buyer Business Activities as manufacturers or distributors: any Buyer Business Activity containing “MANUF” or “DISTRIB.”

<sup>30</sup> Other Buyers have Buyer Business Activity containing “IMPORT”, “EXPORT”, or “RESEARCHER.”

- Transactions where the Drug Code from the NDC Dictionary is not one of the 14 opioids listed in Table 1.
- Transactions where the Action Indicator code, Correction Number, or both suggest the reported transaction is erroneous.
- Transactions involving reverse distributors, analytical labs, importers, exporters, or researchers.
- Transactions reported by the registrant receiving the shipment when two registrants reported the same transaction, keeping the transaction reported by the registrant sending the shipment.
- Transactions with obvious errors in the reported Quantity.
- Transactions where the Transaction Code is “X” (Lost-in-Transit.)

60. I also corrected the Calculated Base Weight In Grams when it was calculated using an incorrect Ingredient Base Weight from the NDC Dictionary. Appendix 2 provides a detailed explanation of these exclusions and corrections.

#### **E. Comparing ARCOS Data to Retail Drug Summary Reports**

61. The DEA publishes six ARCOS Retail Drug Summary Reports (“RDSR”) each year, which summarize the weight of opioids reported in ARCOS transactions by various combinations of Drug Code, Calendar Quarter, Buyer State, Buyer Zip Code, or Buyer’s business activity.<sup>31</sup> The

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<sup>31</sup> The six summary reports are updated on an ad hoc basis. The DEA website states that the summary reports are “susceptible to future updates and corrections, without notice, as new information is obtained”

([www.deadiversion.usdoj.gov/arcos/retail\\_drug\\_summary/index.html](http://www.deadiversion.usdoj.gov/arcos/retail_drug_summary/index.html)).

least aggregated Retail Drug Summary Report, Report 1, aggregates opioid weight by quadruples of Drug Code, Calendar Quarter, Buyer's State, and the first three digits of the Buyer's Zip Code. As a check on my procedures for correcting the ARCOS Data, I compared the corrected ARCOS Data to ARCOS Retail Drug Summary Report 1.

62. I calculated the total Calculated Base Weight in Grams in the corrected ARCOS Data for each Drug Code, Calendar Quarter, Buyer's State, and three-digit Buyer's Zip Code. I then compared the weights I calculated to the weights reported in ARCOS Retail Drug Summary Report 1.<sup>32</sup>

63. There are 409,061 Drug Code/Calendar Quarter/State/3-digit zip code quadruples in either the ARCOS Data or the RDSR dataset. 408,389 of these observations are in both datasets, 457 are only in the ARCOS Data and 215 are only in the RDSR data. See Table 5.

64. The 457 observations that are in the ARCOS Data but not in the RDSRs have a total Calculated Base Weight in Grams of 217,068 grams. 216,544 grams (99.8%) of the 217,068 grams are from zip code 851\*\* in Arizona.<sup>33</sup> The RDSRs do not report any weights for zip code 851\*\* in 2006 and 2007, even though there are shipments to Buyers in this zip code in 2006 and 2007 in the ARCOS Data and the RDSRs closely match the ARCOS data for 851\*\* after 2007. Other than the observations Retail Drug Summary Report 1 is missing for zip code 851\*\* in 2006 and 2007, only 3,231 grams

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<sup>32</sup> I compared the weights for all quadruples created using all 14 Drug Codes in the ARCOS Data, every calendar quarter from 2006 through 2014, and all 50 states, the District of Columbia, Puerto Rico, American Samoa, and the Virgin Islands.

<sup>33</sup> 109 of the 457 transactions are from zip code 851\*\* in Arizona.

are in observations where there is not some data in both the ARCOS Data and RDSRs out of 1.4 billion grams.

**Table 5 Comparison Corrected ARCOS Data and RDSR**

<b>Drug Code</b>	Drug Code/Quarter/State/ 3-digit Zip Codes in Both Datasets		Drug Code/Quarter/State/ Zip Codes in ARCOS Only		Drug Code/Quarter/State/ Zip Codes in RDSR Only	
	<b>N</b>	<b>Weight of Base Drug (ARCOS)</b>	<b>N</b>	<b>Weight of Base Drug</b>	<b>N</b>	<b>Weight of Base Drug</b>
9780	21,175	27,832,183	27,836,251	0	0	1
9220L	13,821	17,098	16,555	26	64	27
9639	30,138	312,322	5,549,118	11	21	34
9064	31,923	13,056,340	12,949,923	34	403	5
9801	32,116	4,383,862	4,266,080	12	501	12
9652	31,287	11,059,802	10,638,657	12	583	13
9120	23,214	755,277	746,160	299	590	42
9150	32,042	12,838,084	12,899,632	8	930	6
9230	32,049	22,785,269	23,105,649	11	4,407	11
9050	32,155	140,440,556	149,474,318	8	24,695	13
9250B	32,075	133,963,921	134,698,794	8	11,505	9
9193	32,164	337,565,862	340,741,300	10	41,620	16
9300	32,111	195,236,784	195,377,422	10	54,031	13
9143	32,119	489,503,746	490,414,951	8	77,718	13
<b>Total</b>	<b>408,389</b>	<b>1,389,751,107</b>	<b>1,408,714,811</b>	<b>457</b>	<b>217,068</b>	<b>215</b>
						<b>2,707</b>

65. It is possible that both the ARCOS Data and the RDSRs have drug weights, but the weights differ between the ARCOS Data and the RDSRs data. To test this possibility, I calculate the ratio of the weight of each drug, each quarter, each state and 3-digit zip code reported in the RDSRs to the weights I calculated from the ARCOS transactions for the observations in both the RDSRs and the ARCOS transactions. A ratio of 1 (less than 1, more than 1) means the RDSRs summary weights equal (are less than, are more than) the weights I aggregate up to using the ARCOS transaction data.

66. Table 6 reports the results of this test of the ARCOS Data. 270,300 or 66.2% of the 408,389 Drug Code/Quarter/State/3-digit zip code quadruple observations in both ARCOS and the RDSRs have ratios between 0.995 and 1.005. That is, 2/3<sup>rds</sup> of the observations have RDSRs reported summary weights within 0.5% of the weights I aggregate up from the ARCOS

transaction data. 72.4% of the observations have RDSRs reported summary weights within 1.0% of the weights I aggregate up from the processed ARCOS transaction data.

67. The RDSRs confirm the accuracy of the ARCOS Data I received. The correlation between the RDSRs' reported drug weight and the weights I calculate from the ARCOS Data is **0.999** on a scale from -1.00 to +1.00.

**Table 6 Ratios of Retail Drug Summary Report and ARCOS Drug Weights**

<b>Drug Code</b>	<b>N</b>	<b>N(%)</b>	<b>1st Percentile</b>	<b>5th Percentile</b>	<b>25th Percentile</b>	<b>50th Percentile</b>	<b>75th Percentile</b>	<b>95th Percentile</b>	<b>99th Percentile</b>
9050	32,155	7.9%	0.97	1.01	1.04	1.07	1.11	1.20	1.32
9064	31,923	7.8%	0.76	0.92	1.00	1.00	1.00	1.02	1.09
9120	23,214	5.7%	0.00	0.71	1.00	1.00	1.00	1.01	1.19
9143	32,119	7.9%	0.90	0.97	1.00	1.00	1.00	1.02	1.11
9150	32,042	7.8%	0.82	0.97	1.00	1.00	1.00	1.03	1.28
9193	32,164	7.9%	0.89	0.98	1.00	1.00	1.00	1.04	1.35
9220L	13,821	3.4%	0.93	0.93	0.99	1.00	1.00	1.03	1.03
9230	32,049	7.8%	0.89	0.98	1.00	1.00	1.01	1.12	1.37
9250B	32,075	7.9%	0.86	0.99	1.00	1.00	1.00	1.02	1.30
9300	32,111	7.9%	0.88	0.98	1.00	1.00	1.00	1.03	1.17
9639	30,138	7.4%	0.91	1.00	1.00	1.00	1.00	1.00	1.06
9652	31,287	7.7%	0.75	0.94	1.00	1.00	1.00	1.00	1.10
9780	21,175	5.2%	0.93	1.00	1.00	1.00	1.00	1.00	1.07
9801	32,116	7.9%	0.84	0.95	0.98	1.00	1.00	1.06	1.31
<b>Total</b>	<b>408,389</b>	<b>100.0%</b>	<b>0.81</b>	<b>0.96</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.09</b>	<b>1.24</b>

## **F. Shipments to Dispensers in ARCOS Data**

68. Table 7 summarizes the shipments to Dispensers in the ARCOS Data, grouped by the Reporter's Business Activity. Distributors account for 98.6% of Dosage Units, 97.9% of Calculated Base Weight in Grams and 97.9% of MME shipped to Dispensers. Manufacturers account for the remaining 1.4% of Dosage Units, 2.1% of Calculated Base Weight in Grams and 2.1% of MME shipped to Dispensers.

**Table 7 Transactions in the ARCOS Data by Reporter's Business Activity**

<b>Reporter Business Activity</b>	<b>Transactions</b>	<b>Dosage Units</b>	<b>Dosage Units %</b>	<b>Calculated Base Weight</b>	<b>Calculated Weight %</b>	<b>MME</b>	<b>MME %</b>
Distributor	421,688,737	133,696,183,474	98.56%	1,356,774,602	97.93%	2,680,939,090,026	97.90%
Manufacturer	2,756,345	1,955,463,856	1.44%	28,614,923	2.07%	57,352,346,163	2.09%
Manufacturer (Bulk)	236	0	0.00%	24,138	0.00%	109,124,308	0.00%
Chempack/Sns Distributor	5	3,100	0.00%	12	0.00%	12,108	0.00%
Chemical Manufacturer	13	100	0.00%	1	0.00%	1,535	0.00%
<b>Total</b>	<b>424,445,336</b>	<b>135,651,650,530</b>	<b>100.00%</b>	<b>1,385,413,675</b>	<b>100.00%</b>	<b>2,738,400,574,140</b>	<b>100.00%</b>

69. Table 8 summarizes the same shipments to Dispensers, grouped by Buyer's Business Activity. Chain and retail pharmacies received 90% of Dosage Units and 81.0% of MME.

**Table 8 Transactions in the ARCOS Data by Buyer's Business Activity**

<b>Buyer Business Activity</b>	<b>Transactions</b>	<b>Dosage Units</b>	<b>Dosage Units %</b>	<b>Calculated Base Weight</b>	<b>Calculated Weight %</b>	<b>MME</b>	<b>MME %</b>
Chain Pharmacy	246,993,756	73,846,902,224	54.44%	666,098,190	48.08%	1,233,742,133,114	45.05%
Retail Pharmacy	140,928,109	48,183,196,197	35.52%	513,421,684	37.06%	984,595,895,476	35.96%
Maint & Detox	470,511	272,879,042	0.20%	54,709,104	3.95%	206,582,513,676	7.54%
Hospital/Clinic	27,089,943	4,435,827,523	3.27%	47,571,404	3.43%	95,242,525,192	3.48%
Hosp/Clinic- VA	2,053,498	3,146,704,703	2.32%	30,723,236	2.22%	55,414,503,916	2.02%
Comp/Maint/Detox	13,065	66,181,228	0.05%	12,379,759	0.89%	47,864,583,656	1.75%
M/O Pharmacy	1,015,020	2,068,917,079	1.53%	22,736,201	1.64%	40,193,271,544	1.47%
Maintenance	34,551	60,050,461	0.04%	9,232,603	0.67%	37,399,070,506	1.37%
Practitioner	4,365,300	688,149,212	0.51%	7,234,690	0.52%	10,911,646,458	0.40%
Pharmacy - Fed	36,783	1,766,946,083	1.30%	11,013,648	0.79%	7,505,331,082	0.27%
Hosp/Clinic- Mil	455,482	565,110,433	0.42%	4,305,257	0.31%	6,314,893,792	0.23%
Practitioner-DW/100	173,678	72,404,042	0.05%	880,718	0.06%	3,189,084,906	0.12%
Hosp/Clinic Fed	252,979	197,583,781	0.15%	1,892,015	0.14%	2,282,801,280	0.08%
Compound/Maint	1,286	2,521,190	0.00%	581,802	0.04%	2,119,819,133	0.08%
Practitioner-DW/30	142,702	81,329,236	0.06%	1,134,323	0.08%	2,024,621,648	0.07%
Central Fill Pharmacy	177,455	158,835,097	0.12%	1,062,841	0.08%	1,432,551,008	0.05%
Practitioner-DW/275	78,406	14,434,889	0.01%	156,531	0.01%	1,041,776,185	0.04%
Other*	162,812	23,678,110	0.02%	279,668	0.02%	543,551,549	0.02%
<b>Total</b>	<b>424,445,336</b>	<b>135,651,650,530</b>	<b>100.00%</b>	<b>1,385,413,675</b>	<b>100.00%</b>	<b>2,738,400,574,122</b>	<b>100.00%</b>

\* Each of the following Buyer Business Activities account for 0.01% or less of Dosage Units, Calculated Base Weight, and MME: Automated Dispensing System, Canine Handler, Chain Hosp/Clinic, Compound/Detox, Detoxification, MLP-Ambulance Service, MLP-Animal Shelter, MLP-Dept Of State, MLP-Euthanasia Technician, MLP-Military, MLP-Naturopathic Physician, MLP-Nurse Practitioner, MLP-Nurse Practitioner-DW/100, MLP-Nurse Practitioner-DW/30, MLP-Optometrist, MLP-Physician Assistant, MLP-Physician Assistant-DW/100, MLP-Physician Assistant-DW/30, MLP-Registered Pharmacist, Pharmacy- Mil, Practitioner-Military, and Teaching Institution

70. Table 9 summarizes the shipments to Dispensers reported in the ARCOS Data, by Drug Name sorted by MME. I separate the two treatment drugs - methadone and buprenorphine – from the other twelve opioids. 81.8%

of the Dosage Units, 59.6% of the drug weight and 39.0% of the MME are in hydrocodone and oxycodone transactions. Fentanyl's ranking by MME is much higher than its ranking by Dosage Units and Calculated Base Weight because of fentanyl's extraordinary potency.

Table 9 Dispenser Transactions in the ARCOS Data, by Drug Name

<b>Drug Name</b>	<b># of Transactions</b>	<b>Dosage Units</b>	<b>Dosage Units %</b>	<b>Calculated Base Weight</b>	<b>Calculated Weight %</b>	<b>MME</b>	<b>MME %</b>
Oxycodone	102,506,041	39,443,630,888	29.08%	487,790,154	35.21%	731,685,231,566	26.72%
Fentanyl	40,394,370	827,665,591	0.61%	4,254,573	0.31%	429,748,696,115	15.69%
Hydrocodone	169,213,326	71,498,484,824	52.71%	337,372,776	24.35%	337,372,775,584	12.32%
Morphine	36,462,788	6,160,024,567	4.54%	194,933,834	14.07%	194,933,833,974	7.12%
Hydromorphone	13,585,979	2,508,943,791	1.85%	12,802,431	0.92%	51,209,722,227	1.87%
Oxymorphone	4,680,598	603,913,954	0.45%	10,692,502	0.77%	32,077,506,313	1.17%
Codeine	13,527,178	5,544,062,787	4.09%	139,874,124	10.10%	20,981,118,649	0.77%
Tapentadol	2,683,189	341,800,982	0.25%	27,775,137	2.00%	11,110,054,972	0.41%
Meperidine	3,714,651	277,898,650	0.20%	22,431,778	1.62%	2,243,177,782	0.08%
Opium, Powdered	256,128	6,413,324	0.00%	311,913	0.02%	311,912,513	0.01%
Dihydrocodeine	577,799	35,923,889	0.03%	742,597	0.05%	185,649,366	0.01%
Levorphanol	52,699	12,966,499	0.01%	16,690	0.00%	183,588,300	0.01%
Buprenorphine	23,135,402	1,798,787,322	1.33%	12,952,085	0.93%	393,584,618,696	14.37%
Methadone	13,655,188	6,591,133,464	4.86%	133,463,081	9.63%	532,772,688,062	19.46%
<b>Total</b>	<b>424,445,336</b>	<b>135,651,650,530</b>	<b>100.00%</b>	<b>1,385,413,675</b>	<b>100.00%</b>	<b>2,738,400,574,120</b>	<b>100.00%</b>

71. The distribution of shipments to Dispensers reported in the ARCOS Data by the Buyer's State is presented in Table 10. Dispensers in California received the most Dosage Units, Calculated Base Weight in Grams and MME of any state, followed by Florida, New York, Pennsylvania, Texas and Ohio. These six states account for a little more than 36% of the opioid shipments by Dosage Units, by Calculated Base Weight in Grams and by MME.

72. States at the top of Table 10 are also the most populous states so the last two columns list the states' average annual MME per capita and ranking by average MME per capita over the 2006-2014 period. I have highlighted in bold the top 10 states by average annual MME per capita.

Table 10 Transactions by Buyer's State

Buyer State	Transactions	Dosage Units	% Base Weight	Calculated Base Weight		MME	% Annual MME per Capita	MME Per Capita Rank
				%	%			
California	34,116,345	14,265,132,224	10.52%	144,147,037	10.40%	246,864,541,563	9.01%	734.8
<b>Florida</b>	<b>27,628,426</b>	<b>9,099,330,210</b>	<b>6.71%</b>	<b>118,357,248</b>	<b>8.54%</b>	<b>226,144,996,345</b>	<b>8.26%</b>	<b>1,333.3</b>
New York	20,740,851	5,966,272,302	4.40%	73,009,828	5.27%	172,892,443,895	6.31%	990.0
Pennsylvania	19,606,575	5,665,746,405	4.18%	64,932,734	4.69%	148,534,872,481	5.42%	1,298.4
Texas	27,614,019	8,737,945,396	6.44%	71,856,185	5.19%	129,487,655,984	4.73%	570.0
Ohio	17,248,190	5,806,957,336	4.28%	54,539,897	3.94%	111,223,947,220	4.06%	1,071.0
<b>Tennessee</b>	<b>13,686,994</b>	<b>5,993,947,214</b>	<b>4.42%</b>	<b>57,448,467</b>	<b>4.15%</b>	<b>102,641,656,039</b>	<b>3.75%</b>	<b>1,794.3</b>
Michigan	15,665,617	5,094,496,732	3.76%	50,508,260	3.65%	91,323,801,371	3.33%	1,027.4
North Carolina	15,654,076	4,441,013,844	3.27%	42,677,459	3.08%	87,372,100,437	3.19%	1,014.0
New Jersey	10,342,159	2,589,817,832	1.91%	36,888,703	2.66%	83,481,448,017	3.05%	1,053.6
Georgia	14,464,310	3,802,194,109	2.80%	37,640,793	2.72%	75,391,358,665	2.75%	862.5
Massachusetts	7,058,475	2,379,990,293	1.75%	26,492,427	1.91%	71,981,327,783	2.63%	1,218.3
Illinois	12,612,003	3,823,214,843	2.82%	34,861,504	2.52%	67,936,505,921	2.48%	587.8
Maryland	7,629,534	2,146,560,799	1.58%	28,424,966	2.05%	66,106,984,483	2.41%	1,269.0
Washington	10,156,644	3,498,898,375	2.58%	32,581,129	2.35%	65,420,242,836	2.39%	1,078.3
Arizona	9,178,310	3,273,706,576	2.41%	37,735,956	2.72%	64,285,967,929	2.35%	1,114.9
Indiana	10,773,851	3,521,917,055	2.60%	31,448,358	2.27%	64,109,285,889	2.34%	1,097.6
<b>Alabama</b>	<b>9,959,358</b>	<b>2,963,633,101</b>	<b>2.18%</b>	<b>28,990,594</b>	<b>2.09%</b>	<b>57,270,835,531</b>	<b>2.09%</b>	<b>1,329.7</b>
Virginia	10,171,929	2,872,487,719	2.12%	27,961,583	2.02%	56,413,488,176	2.06%	781.1
<b>Kentucky</b>	<b>8,671,161</b>	<b>2,947,906,562</b>	<b>2.17%</b>	<b>24,361,382</b>	<b>1.76%</b>	<b>52,374,434,100</b>	<b>1.91%</b>	<b>1,338.4</b>
Missouri	10,022,961	2,941,804,636	2.17%	28,621,758	2.07%	51,080,051,512	1.87%	946.6
Louisiana	7,758,253	2,227,529,349	1.64%	21,955,349	1.58%	46,554,530,799	1.70%	1,138.1
Wisconsin	8,457,886	2,278,805,560	1.68%	22,941,012	1.66%	45,620,840,529	1.67%	890.8
Oregon	6,501,855	2,456,823,189	1.81%	23,192,996	1.67%	45,160,716,051	1.65%	1,307.7
Connecticut	4,679,646	1,219,237,554	0.90%	16,840,541	1.22%	42,067,293,465	1.54%	1,305.6
Oklahoma	7,754,529	2,347,961,706	1.73%	23,800,260	1.72%	41,501,551,598	1.52%	1,226.6
South Carolina	7,416,518	2,956,556,366	2.18%	25,838,500	1.87%	40,865,381,018	1.49%	979.5
Colorado	7,121,903	2,050,906,201	1.51%	19,449,200	1.40%	36,614,699,322	1.34%	805.9
<b>Nevada</b>	<b>4,039,930</b>	<b>2,143,345,688</b>	<b>1.58%</b>	<b>20,389,639</b>	<b>1.47%</b>	<b>32,505,416,537</b>	<b>1.19%</b>	<b>1,336.3</b>
<b>West Virginia</b>	<b>4,032,495</b>	<b>1,374,953,247</b>	<b>1.01%</b>	<b>12,756,235</b>	<b>0.92%</b>	<b>27,710,480,517</b>	<b>1.01%</b>	<b>1,660.4</b>
Utah	4,648,363	1,191,841,154	0.88%	13,030,889	0.94%	27,531,764,590	1.01%	1,102.3
Minnesota	5,782,242	1,535,649,700	1.13%	13,896,692	1.00%	27,168,699,232	0.99%	568.4
Arkansas	5,716,135	1,570,116,921	1.16%	15,005,209	1.08%	24,092,530,804	0.88%	916.2
Mississippi	5,351,588	1,386,176,032	1.02%	12,141,217	0.88%	23,801,384,700	0.87%	890.3
Kansas	4,645,815	1,446,151,301	1.07%	12,814,722	0.92%	22,137,306,013	0.81%	860.5
<b>Maine</b>	<b>2,289,289</b>	<b>702,600,065</b>	<b>0.52%</b>	<b>7,765,542</b>	<b>0.56%</b>	<b>20,820,594,825</b>	<b>0.76%</b>	<b>1,742.6</b>
New Mexico	2,714,819	919,096,920	0.68%	9,352,637	0.68%	17,477,821,530	0.64%	940.6
Iowa	4,138,446	994,351,152	0.73%	8,270,308	0.60%	15,032,797,129	0.55%	547.6
New Hampshire	2,011,289	509,797,959	0.38%	5,997,523	0.43%	14,809,345,496	0.54%	1,249.7
<b>Rhode Island</b>	<b>1,348,121</b>	<b>423,647,440</b>	<b>0.31%</b>	<b>5,161,088</b>	<b>0.37%</b>	<b>13,262,708,605</b>	<b>0.48%</b>	<b>1,399.2</b>
<b>Delaware</b>	<b>1,462,882</b>	<b>467,147,993</b>	<b>0.34%</b>	<b>6,165,846</b>	<b>0.45%</b>	<b>12,411,013,365</b>	<b>0.45%</b>	<b>1,532.7</b>
Idaho	2,417,843	695,476,072	0.51%	6,187,731	0.45%	11,836,474,073	0.43%	837.2
Hawaii	1,267,488	446,244,115	0.33%	5,130,595	0.37%	9,034,756,341	0.33%	736.1
Montana	1,929,339	485,957,713	0.36%	4,703,802	0.34%	8,888,624,223	0.32%	997.1
Nebraska	2,559,570	547,121,781	0.40%	4,695,675	0.34%	8,469,741,825	0.31%	514.3
<b>Vermont</b>	<b>1,021,829</b>	<b>262,308,022</b>	<b>0.19%</b>	<b>2,682,428</b>	<b>0.19%</b>	<b>8,365,302,057</b>	<b>0.31%</b>	<b>1,485.2</b>
Alaska	983,607	303,646,336	0.22%	3,094,359	0.22%	6,309,325,701	0.23%	981.8
South Dakota	1,112,368	277,677,404	0.20%	2,576,594	0.19%	4,483,095,365	0.16%	610.3
District of Columbia	381,866	145,978,288	0.11%	2,061,012	0.15%	3,980,538,365	0.15%	731.0
Wyoming	960,004	238,165,303	0.18%	2,128,620	0.15%	3,870,354,803	0.14%	762.0
North Dakota	937,630	213,406,437	0.16%	1,901,186	0.14%	3,677,539,067	0.13%	605.8
Total	424,445,336	135,651,650,530	100.00%	1,385,413,675	100.00%	2,738,400,574,122	100.00%	

73. The distribution of shipments to Dispensers reported in the ARCOS Data by year is presented in Table 11. The number of transactions, Dosage Units, Calculated Base Weight in Grams and MME all increased between 40% and 50% from 2006 to 2011.

**Table 11 Transactions by Year**

<b>Year</b>	<b>Transactions</b>	<b>Dosage Units</b>	<b>Dosage Units %</b>	<b>Calculated Base Weight</b>	<b>Calculated Weight %</b>	<b>MME</b>	<b>MME %</b>
2006	39,555,401	11,739,835,283	8.65%	122,596,756	8.85%	227,932,856,076	8.32%
2007	43,199,221	13,039,464,062	9.61%	133,746,179	9.65%	256,113,510,889	9.35%
2008	44,277,708	14,161,966,782	10.44%	143,369,466	10.35%	272,470,450,720	9.95%
2009	45,512,661	15,159,741,337	11.18%	154,460,272	11.15%	298,050,302,275	10.88%
2010	48,012,352	15,964,409,642	11.77%	165,940,621	11.98%	325,429,971,159	11.88%
2011	51,048,709	16,961,507,438	12.50%	173,058,621	12.49%	337,643,155,421	12.33%
2012	51,898,574	16,833,678,959	12.41%	170,937,528	12.34%	342,222,622,755	12.50%
2013	52,249,937	16,130,731,009	11.89%	162,374,915	11.72%	337,765,488,198	12.33%
2014	48,690,773	15,660,316,018	11.54%	158,929,318	11.47%	340,772,216,622	12.44%
<b>Total</b>	<b>424,445,336</b>	<b>135,651,650,530</b>	<b>100.00%</b>	<b>1,385,413,675</b>	<b>100.00%</b>	<b>2,738,400,574,116</b>	<b>100.00%</b>

## **VI. Opioid Shipment Summary**

### **A. ARCOS Summary on Shipment to Cabell County and the City of Huntington, WV**

74. In this section, I summarize opioid shipment transactions by drug, by reporter's business activity, by buyer's business activity, and by year for Cabell County and the City of Huntington, WV.

75. According to the ARCOS Data, between 2006 and 2014, Dispensers in Cabell County and the City of Huntington, WV received 3.3 billion MME of opioids. Table 12 through Table 15 (also Appendix 6A Table 1a-d) summarize those transactions reported in the ARCOS Data for Cabell County and the City of Huntington, WV.

76. According to the ARCos Data, between 2006 and 2014, Dispensers in Cabell County and the City of Huntington, WV received 127.9 million Dosage Units of opioids. As shown in Table 12, oxycodone accounted for 32.6% of all Dosage Units and 22.5% of MME. Hydrocodone accounted for 53.3% of all Dosage Units and 9.5% of MME. Buprenorphine and fentanyl have a large MME relative to their Dosage Units because both are often prescribed as skin patches, which deliver the drug for up to one week.

Table 12 Transactions in Cabell County and the City of Huntington, WV by Drug

<b>Drug Name</b>	<b># of Transactions</b>	<b>Dosage Units</b>	<b>Dosage Units %</b>	<b>MME</b>	<b>MME %</b>
Oxycodone	77,260	41,632,500	32.55%	738,442,406	22.49%
Fentanyl	33,856	693,654	0.54%	380,439,319	11.59%
Hydrocodone	130,764	68,179,000	53.31%	312,916,961	9.53%
Morphine	27,092	5,675,899	4.44%	168,681,159	5.14%
Oxymorphone	6,508	789,860	0.62%	47,493,620	1.45%
Hydromorphone	8,274	982,178	0.77%	28,921,338	0.88%
Codeine	8,146	2,132,655	1.67%	9,247,220	0.28%
Tapetal	1,332	140,100	0.11%	4,378,400	0.13%
Opium, Powdered	411	10,980	0.01%	586,800	0.02%
Meperidine	692	28,500	0.02%	390,563	0.01%
Levorphanol	24	4,200	0.00%	54,087	0.00%
Dihydrocodeine	100	6,857	0.01%	23,241	0.00%
Buprenorphine	21,103	2,634,828	2.06%	584,911,335	17.82%
Methadone	8,514	4,991,700	3.90%	1,006,496,311	30.66%
<b>Total</b>	<b>324,076</b>	<b>127,902,911</b>	<b>100.00%</b>	<b>3,282,982,760</b>	<b>100.00%</b>

77. Table 13 shows that virtually all transactions involving Dispensers in Cabell County and the City of Huntington, WV were reported by Distributors.

**Table 13 Transactions in Cabell County and the City of Huntington, WV by Reporter's Business Activity**

<b>Reporter</b>					
<b>Business Activity</b>	<b># of Transactions</b>	<b>Dosage Units</b>	<b>Dosage Units %</b>	<b>MME</b>	<b>MME %</b>
Distributor	322,780	127,864,851	99.97%	3,052,915,737	92.99%
Manufacturer	1,296	38,060	0.03%	230,067,023	7.01%
Manufacturer (Bulk)	0	0	0.00%	0	0.00%
<b>Total</b>	<b>324,076</b>	<b>127,902,911</b>	<b>100.00%</b>	<b>3,282,982,760</b>	<b>100.00%</b>

78. In Cabell County and the City of Huntington, WV, retail pharmacies accounted for 43.4% of opioid Dosage Units and 36.6% of opioid MME, and chain pharmacies for 33.9% of Dosage Units and 22.3% of MME on all 14 opioid drugs. The only buyer in Main & Detox, Huntington Treatment Center, only purchased buprenorphine and methadone, which accounted for only 0.6% of Dosage Units, but 25.7% of MME. See Table 14.

Table 14 Transactions in Cabell County and the City of Huntington, WV by Buyer's Business Activity

<b>Buyer Business Activity</b>	<b># of Transactions</b>	<b>Dosage Units</b>	<b>Dosage Units %</b>	<b>MME</b>	<b>MME %</b>
Retail Pharmacy	155,190	55,539,321	43.42%	1,202,221,843	36.62%
Maint & Detox	746	771,420	0.60%	844,659,018	25.73%
Chain Pharmacy	121,982	43,303,313	33.86%	733,172,274	22.33%
Hosp/Clinic-VA	12,737	22,858,718	17.87%	322,776,384	9.83%
Hospital/Clinic	30,685	4,782,196	3.74%	158,337,562	4.82%
M/O Pharmacy	634	507,245	0.40%	18,634,974	0.57%
Practitioner-DW/275	140	7,504	0.01%	1,507,282	0.05%
Practitioner	1,848	129,026	0.10%	1,227,302	0.04%
Practitioner-DW/30	67	1,982	0.00%	297,289	0.01%
Practitioner-DW/100	23	1,966	0.00%	146,528	0.00%
MLP-Nurse Practitioner	14	180	0.00%	1,199	0.00%
MLP-Physician Assistant	9	40	0.00%	1,073	0.00%
MLP-Ambulance Service	1	0	0.00%	30	0.00%
<b>Total</b>	<b>324,076</b>	<b>127,902,911</b>	<b>100.00%</b>	<b>3,282,982,760</b>	<b>100.00%</b>

79. Table 15 lists all Dispenser transactions in Cabell County and the City of Huntington, WV by transaction year.

**Table 15 Transactions in Cabell County and the City of Huntington, WV by Year**

<b>Transaction Year</b>	<b># of Transactions</b>	<b>Dosage Units</b>	<b>Units %</b>	<b>MME</b>	<b>MME %</b>
2006	32,221	13,115,131	10.25%	364,042,774	11.09%
2007	35,675	14,643,414	11.45%	370,363,692	11.28%
2008	35,239	15,919,340	12.45%	351,262,510	10.70%
2009	37,282	15,770,203	12.33%	368,069,707	11.21%
2010	37,978	14,836,779	11.60%	386,724,054	11.78%
2011	38,395	14,761,140	11.54%	376,467,892	11.47%
2012	37,001	13,436,335	10.51%	351,958,896	10.72%
2013	36,955	12,257,857	9.58%	336,517,673	10.25%
2014	33,330	13,162,712	10.29%	377,575,562	11.50%
<b>Total</b>	<b>324,076</b>	<b>127,902,911</b>	<b>100.00%</b>	<b>3,282,982,760</b>	<b>100.00%</b>

80. Table 16 lists the top 20 Labelers of the 12 drugs, excluding buprenorphine and methadone, by MME - accounting for 97.4% of the total MME shipped to Dispensers - in Cabell County and the City of Huntington, WV.

Table 16 Top 20 Labelers, Cabell County and the City of Huntington, WV, ARCOS Data, 2006-2014.

<b>Rank</b>	<b>Labeler</b>	<b>MME</b>	<b>Percent</b>	<b>Cumulative</b>
1	SpecGx LLC	467,340,622	27.63%	27.63%
2	Actavis Pharma, Inc.	389,416,798	23.02%	50.65%
3	Purdue Pharma LP	153,524,103	9.08%	59.72%
4	Mylan Pharmaceuticals, Inc.	143,335,667	8.47%	68.20%
5	Par Pharmaceutical	141,061,474	8.34%	76.54%
6	Sandoz Inc	84,490,450	4.99%	81.53%
7	Janssen Pharmaceuticals, Inc.	51,481,998	3.04%	84.58%
8	Endo Pharmaceuticals, Inc.	46,015,226	2.72%	87.30%
9	KVK-Tech, Inc.	29,013,764	1.72%	89.01%
10	Rhodes Pharmaceuticals	24,074,415	1.42%	90.43%
11	West-Ward Pharmaceuticals Corp.	22,270,157	1.32%	91.75%
12	Amneal Pharmaceuticals LLC	18,174,333	1.07%	92.82%
13	Ethex Corporation	16,923,939	1.00%	93.83%
14	Hospira, Inc.	16,711,373	0.99%	94.81%
15	Teva Pharmaceuticals USA, Inc.	14,802,439	0.88%	95.69%
16	Baxter Healthcare Corporation	7,742,203	0.46%	96.15%
17	Apotex Corp.	7,482,195	0.44%	96.59%
18	Sun Pharmaceutical Industries, Inc.	5,407,951	0.32%	96.91%
19	Xanodyne Pharmaceuticals, Inc.	4,684,086	0.28%	97.18%
20	Professional Compounding Centers of America dba PCCA	4,185,149	0.25%	97.43%

81. Table 17 and Table 18 show the oxycodone and hydrocodone shipments to selected pharmacies in Cabell County and the City of Huntington, WV, in MME and Distributor market shares, respectively (see also Appendix 10K).<sup>34</sup>

**Table 17 Oxycodone and Hydrocodone Shipments to Selected Pharmacies in Cabell County and the City of Huntington, WV, MME, 2006 - 2014**

	DU Market Share % <sup>9</sup>	MME Market Share % <sup>10</sup>	Distributor MME to the Pharmacy							Total DU	Total MME
			ABDC	MCK	CAH	Self-Distributed	Other	Total DU	Total MME		
<b><i>Selected Independent Pharmacies</i></b>											
Fruth (4 pharmacies) <sup>1</sup>	18.24%	13.39%	61,348,864	240,495	51,640,559	-	3,105,795	14,850,710	116,335,714		
SafeScript (1 pharmacy) <sup>2</sup>	5.42%	13.30%	98,468,248	-	-	-	17,121,784	4,414,640	115,590,031		
Medicine Shoppe (2 pharmacies) <sup>3</sup>	7.25%	11.99%	10,082,892	9,081	82,825,762	-	11,285,022	5,900,850	104,202,758		
McCloud (1 pharmacy) <sup>4</sup>	5.55%	8.20%	70,714,865	-	-	-	533,856	4,519,980	71,248,721		
Drug Emporium (1 pharmacy) <sup>5</sup>	4.83%	5.72%	49,652,259	-	-	-	71,437	3,928,100	49,723,696		
Selected Independent Totals	41.29%	52.60%	290,267,128	249,576	134,466,321	-	32,117,894	33,614,280	457,100,919		
<b><i>Selected National Chain Pharmacies</i></b>											
CVS (4 pharmacies) <sup>6</sup>	17.45%	14.36%	-	-	83,412,122	41,345,969	-	14,204,630	124,758,090		
Rite Aid (5 pharmacies) <sup>7</sup>	10.81%	8.33%	-	46,612,570	-	25,502,244	307,556	8,801,300	72,422,370		
Walgreens (2 pharmacies) <sup>8</sup>	3.10%	2.90%	8,857,879	17,405	835,817	15,501,912	3,559	2,522,800	25,216,573		
National Chain Totals	31.36%	25.59%	8,857,879	46,629,975	84,247,939	82,350,125	311,116	25,528,730	222,397,034		
Selected Grand Total	72.65%	78.19%	299,125,007	46,879,551	218,714,260	82,350,125	32,429,010	59,143,010	679,497,953		

<sup>34</sup> Selected Pharmacies include: four Fruth pharmacies: Fruth Pharmacy #5 (AF1585922), Fruth Pharmacy #12 (BS1588168), Fruth Pharmacy #2 (AS7523118) and Fruth Pharmacy #11 (BF1434555); SafeScript Pharmacy #6 (BS8246349); two Medicine Shoppe pharmacies: T and J Enterprises Inc DBA Medicine Shoppe (BT5541760) and Medicap Pharmacy (BM7641512); McCloud Family Pharmacy (BM9558733); Drug Emporium (BD0427927); four CVS pharmacies: CVS/Pharmacy # 03391 (BR4365486), CVS/Pharmacy # 04419 (BR4301545), CVS/Pharmacy # 04425 (BR4321787) and CVS/Pharmacy # 03480 (AR6055025); five Rite Aid pharmacies: Rite Aid #968 (AR6070178), Rite Aid #3423 (FR0711552), Rite Aid #3311 (BR3421954), Rite Aid #950 (AC2986872) and Rite Aid Discnt Phcy #3423 (BR3813664); two Walgreens pharmacies: Walgreens #11977 (FW1925568) and Walgreens #11980 (FW1365748).

Table 18 Oxycodone and Hydrocodone Shipments to Selected Pharmacies in Cabell County and the City of Huntington, WV, by Distributor Market Share, 2006 - 2014

DU Market Share % <sup>9</sup>	MME Market Share % <sup>10</sup>	Distributor MME % for the Pharmacy <sup>11</sup>						Total DU	Total MME
		ABDC	MCK	CAH	Self- Distributed	Other			
<b>Selected Independent Pharmacies</b>									
Fruth (4 pharmacies) <sup>1</sup>	18.24%	13.39%	52.73%	0.21%	44.39%	-	2.67%	14,850,710	116,335,714
SafeScript (1 pharmacy) <sup>2</sup>	5.42%	13.30%	85.19%	-	-	-	14.81%	4,414,640	115,590,031
Medicine Shoppe (2 pharmacies) <sup>3</sup>	7.25%	11.99%	9.68%	0.01%	79.49%	-	10.83%	5,900,850	104,202,758
McCloud (1 pharmacy) <sup>4</sup>	5.55%	8.20%	99.25%	-	-	-	0.75%	4,519,980	71,248,721
Drug Emporium (1 pharmacy) <sup>5</sup>	4.83%	5.72%	99.86%	-	-	-	0.14%	3,928,100	49,723,696
<b>Selected Independent Totals</b>	<b>41.29%</b>	<b>52.60%</b>	<b>63.50%</b>	<b>0.05%</b>	<b>29.42%</b>	<b>-</b>	<b>7.03%</b>	<b>33,614,280</b>	<b>457,100,919</b>
<b>Selected National Chain Pharmacies</b>									
CVS (4 pharmacies) <sup>6</sup>	17.45%	14.36%	-	-	66.86%	33.14%	-	14,204,630	124,758,090
Rite Aid (5 pharmacies) <sup>7</sup>	10.81%	8.33%	-	64.36%	-	35.21%	0.42%	8,801,300	72,422,370
Walgreens (2 pharmacies) <sup>8</sup>	3.10%	2.90%	35.13%	0.07%	3.31%	61.48%	0.01%	2,522,800	25,216,573
<b>National Chain Totals</b>	<b>31.36%</b>	<b>25.59%</b>	<b>3.98%</b>	<b>20.97%</b>	<b>37.88%</b>	<b>37.03%</b>	<b>0.14%</b>	<b>25,528,730</b>	<b>222,397,034</b>
<b>Selected Grand Total</b>	<b>72.65%</b>	<b>78.19%</b>	<b>44.02%</b>	<b>6.90%</b>	<b>32.19%</b>	<b>12.12%</b>	<b>4.77%</b>	<b>59,143,010</b>	<b>679,497,953</b>

## B. Defendants' Shipment Summary

82. In addition to receiving the ARCOS Data produced by the DEA, I received Transactional Data produced in discovery by three Defendants, AmerisourceBergen Drug, Cardinal Health, and McKesson Corporation. I analyzed the Defendants' Transactional Data and found that there are small gaps in the data produced by Defendants. I compared transactions in each Defendant's Transactional Data to the ARCOS Data. I matched the transactions based on NDC, Buyer's DEA Number, Quantity, and the transaction date (within ±5 days). After matching the transactions, I converted the transaction Quantity to both Dosage Units and MME.

83. Table 19 presents summary statistics comparing the ARCOS Data and the Defendants' Transactional Data. The transactions summarized in Table 19 consist of all transactions by Dispensers in Cabell County and the City of Huntington, WV from January 1, 2006 through December 31, 2014, involving the 14 opioids in Table 12.

**Table 19 Overlap between ARCOS Data and Defendant Data**

Defendant	Transaction in Both Datasets			Transactions Only in ARCOS				Transactions Only in Defendants					
	Dosage	Unit	MME	Dosage			Unit	MME	%	Dosage	Unit	MME	%
				Unit	%	MME							
Cardinal Health	21,900,738	576,084,297	5,933	0.03%	83,633	0.01%	84,431	0.39%	2,264,666	0.39%			
AmerisourceBergen Drug	41,539,089	841,218,973	32,135	0.08%	1,024,980	0.12%	27,670	0.07%	369,063	0.04%			
McKesson Corporation	30,171,356	601,399,381	3,700	0.01%	28,915	0.00%	67,865	0.22%	957,501	0.16%			
Total	93,611,183	2,018,702,651	41,768	0.04%	1,137,527	0.06%	179,966	0.19%	3,591,230	0.18%			

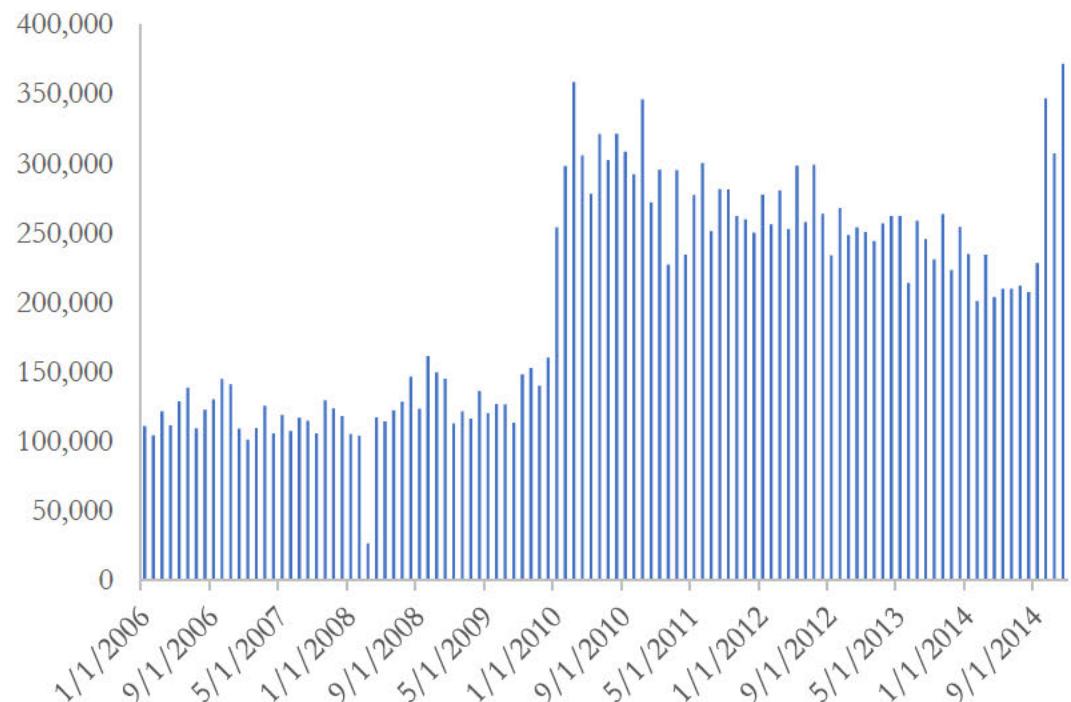
84. Using my matching criteria, over 99.8% of all MME or Dosage Units in either the ARCOS Data or the datasets produced by Defendants are in both the ARCOS Data and the datasets produced by Defendants (*i.e.*, the MME and Dosage Units are in the intersection of the ARCOS Data and the datasets produced by Defendants).

85. The 99.8% overlap between the ARCOS Data and the datasets produced by Defendants demonstrates that the ARCOS Data and the datasets produced by Defendants in discovery are both reliable. The remainder of this section explains the slight differences between the ARCOS Data and the Defendants' data.

1. *Cardinal Health*

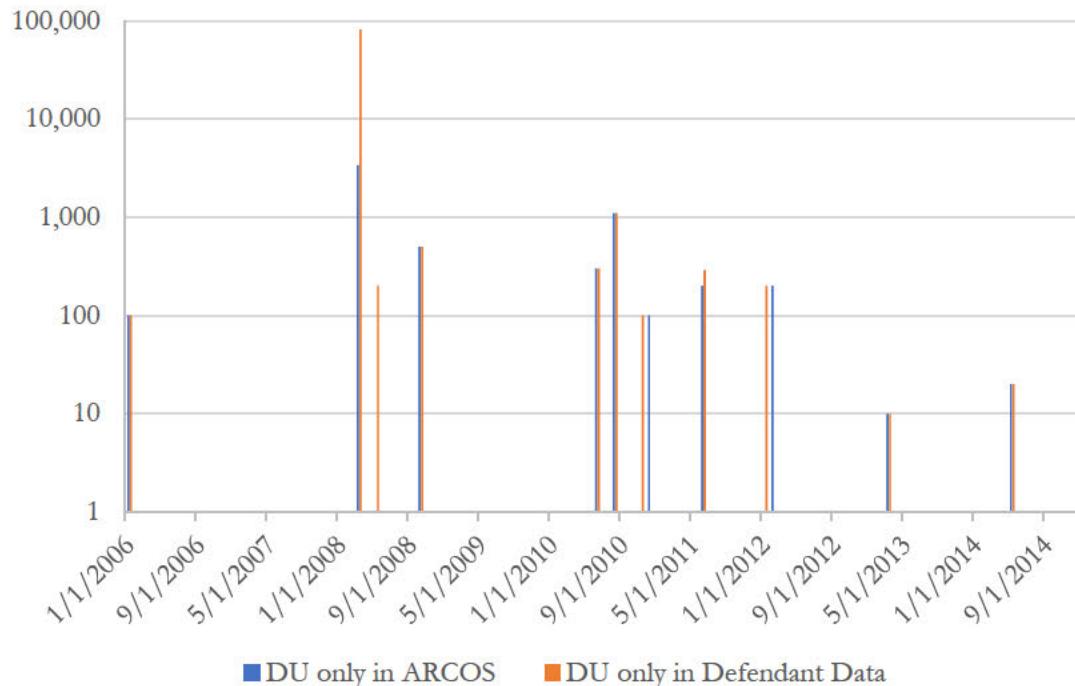
86. Figure 2 shows the matched Dosage Units reported each month in the ARCOS Data and in Cardinal Health's Transactional Data in Cabell County and the City of Huntington, WV.

Figure 2 Dosage Units Reported Both in the ARCOS Data and Cardinal Health's Transactional Data, January 2006 through December 2014



87. Figure 3 shows the Dosage Units reported only in the ARCOS data and only in the Cardinal Health's Transactional Data in logarithm scale in Cabell County and the City of Huntington, WV.

Figure 3 Dosage Units Reported only in the ARCOS Data and only in the Cardinal Health's Transactional Data, January 2006 through December 2014



88. Virtually all of the transactions in Cardinal Health's Transactional Data and in the ARCOS Data match, with the exception of March 2008, when the ARCOS Data appears to be missing much of Cardinal Health's transactions. There are no Cardinal Health shipments to Buyers in Cabell County and the City of Huntington, WV in the ARCOS Data produced by the DEA for 21 consecutive days in March 2008, from March 11 to March 31, 2008, while Cardinal Health's Transactional Data produced in discovery include substantial shipments. The otherwise nearly perfect overlap of the ARCOS Data and the Cardinal Health's Transactional Data suggests that both are accurate and complete although the ARCOS Data should be supplemented

with March 2008 Cardinal Health's Transactional Data produced in discovery.<sup>35</sup>

89. Other very minor differences between Cardinal Health's Transactional Data and the ARCOS Data include transactions that Cardinal Health reversed on the same day it recorded them in its own system and never reported the offsetting pairs of transactions to ARCOS. These transactions have zero impact. Cardinal Health produced those offsetting entries in discovery even though they don't reflect executed transactions and Cardinal Health apparently did not report the offsetting transaction to the ARCOS system in real time. Also, I observed that some offsetting transactions in the ARCOS Data were reported more than 5 days later than Cardinal Health's Transactional Data, causing small mismatches in my comparison.

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<sup>35</sup> In my calculation below I insert these missing March 2008 transactions Cardinal Health produced in discovery into the ARCOS Data.

90. Table 20 summarizes the results of matching ARCOS Data and Cardinal Health's Transactional Data, excluding transactions in March 2008. 99.9% of the Dosage Units and MME reported in transactions in either the ARCOS data or Cardinal Health's Transactional Data are reported in both the ARCOS Data and Cardinal Health's Transactional Data.

**Table 20 Comparison by Drug code in ARCOS Data vs. Cardinal Health's Transactional Data, Excluding March 2008**

<b>Base Drug</b>	<b>Matched DU</b>		<b>Matched MME</b>		<b>Only in ARCOS</b>		<b>Only in Defendant Data</b>			
	<b>DU</b>	<b>MME</b>	<b>DU</b>	<b>%</b>	<b>MME</b>	<b>%</b>	<b>DU</b>	<b>%</b>	<b>MME</b>	<b>%</b>
9050	325,780	1,451,698	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9064	191,070	127,028,210	0	0.00%	0	0.00%	90	0.05%	21600	0.02%
9120	2,200	9,937	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9143	9,906,820	207,398,285	600	0.01%	20171	0.01%	800	0.01%	25550	0.01%
9150	254,356	3,735,262	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9193	8,584,490	47,181,082	1720	0.02%	8748	0.02%	1720	0.02%	8748	0.02%
9220	3,100	39,583	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9230	14,200	118,066	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9250	1,137,400	46,345,178	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9300	864,740	26,626,981	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9639	1,200	55,080	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9652	324,840	18,648,057	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9780	61,860	1,960,600	200	0.32%	4000	0.20%	200	0.32%	4000	0.20%
9801	201,860	94,828,183	10	0.00%	5100	0.01%	10	0.00%	5100	0.01%
<b>Total</b>	<b>21,873,916</b>	<b>575,426,204</b>	<b>2,530</b>	<b>0.01%</b>	<b>38,019</b>	<b>0.01%</b>	<b>2,820</b>	<b>0.01%</b>	<b>64,998</b>	<b>0.01%</b>

91. Table 21 shows the Labelers of oxycodone and hydrocodone shipped by Cardinal Health to Cabell County and the City of Huntington, WV and Labeler market shares in Dosage Units.

**Table 21 Labelers' Market Shares in Cardinal Health Oxycodone and Hydrocodone Shipments in Dosage Units, 2006-2014**

<b>Labeler Name</b>	<b>Oxycodone</b>	<b>Hydrocodone</b>	<b>Total</b>	<b>%</b>
Mallinckrodt/SpecGx LLC	4,056,900	3,391,160	7,448,060	40%
Watson/Actavis/Allergan	2,277,800	3,501,800	5,779,600	31%
Par Pharmaceutical	1,417,500	807,060	2,224,560	12%
Amneal	243,600	677,400	921,000	5%
Purdue	819,100	0	819,100	4%
KVK-Tech, Inc.	334,400	0	334,400	2%
West-Ward	275,400	0	275,400	1%
Sun Pharmaceutical	51,000	99,600	150,600	1%
Ethex Corporation	149,700	0	149,700	1%
UCB, Inc.	0	116,100	116,100	1%
Endo	99,700	0	99,700	1%
Teva	78,600	2,000	80,600	0%
McKesson Corporation	0	49,400	49,400	0%
American Health Packaging	10,300	35,480	45,780	0%
Alvogen, Inc.	43,900	0	43,900	0%
Mylan Pharmaceuticals	25,100	0	25,100	0%
Forest Laboratories	0	15,700	15,700	0%
Major Pharmaceuticals	0	15,500	15,500	0%
Abbott/AbbVie	0	12,300	12,300	0%
Hawthorn Pharmaceuticals	0	6,800	6,800	0%
Other Labelers	74,800	58,420	133,220	1%
<b>Total</b>	<b>9,957,800</b>	<b>8,788,720</b>	<b>18,746,520</b>	<b>100%</b>

92. Table 22 lists the Dispensers that Cardinal Health shipped oxycodone and hydrocodone to in Cabell County and the City of Huntington, WV.

Table 22 Cardinal Health Oxycodone and Hydrocodone Shipments to Dispensers in Dosage Units, 2006-2014

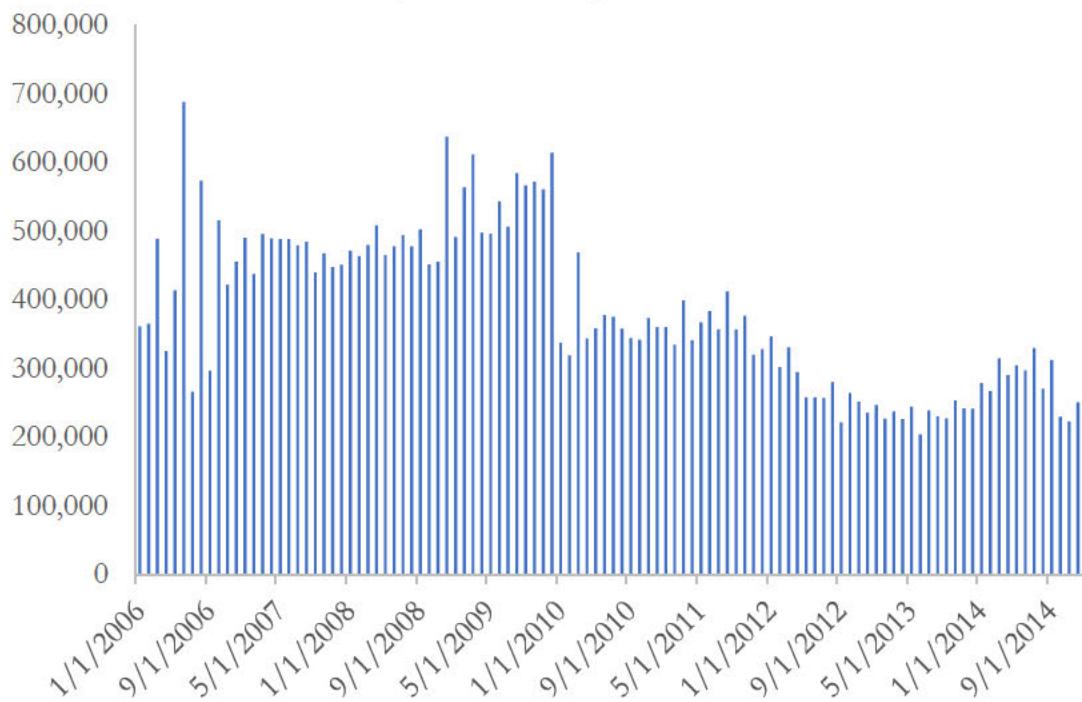
Dispenser Name	Oxycodone	Hydrocodone	Total	%
CVS	4,329,700	777,230	5,106,930	27%
Kroger	1,105,800	217,210	1,323,010	7%
Kmart	184,900	857,760	1,042,660	6%
Walgreen Co	39,800	14,560	54,360	0%
Other Chain Pharmacy	0	0	0	0%
<b>Chain Pharmacy Total</b>	<b>5,660,200</b>	<b>1,866,760</b>	<b>7,526,960</b>	<b>40%</b>
Retail Pharmacy	4,092,760	6,599,730	10,692,490	57%
Closed Door Pharmacy	67,100	112,600	179,700	1%
Mail Order Pharmacy	0	0	0	0%
Other Dispensers	137,740	209,630	347,370	2%
<b>Grand Total</b>	<b>9,957,800</b>	<b>8,788,720</b>	<b>18,746,520</b>	<b>100%</b>

2. *AmerisourceBergen Drug*

93. AmerisourceBergen did not provide Buyer DEA numbers in the Transactional Data it produced, but later provided a dictionary matching the account number with one or multiple DEA numbers.<sup>36</sup>

94. Figure 4 shows the matched Dosage Units reported each month in the ARCOS Data and in AmerisourceBergen's Transactional Data in Cabell County and the City of Huntington, WV.

Figure 4 Dosage Units Reported in the ARCOS Data or AmerisourceBergen's Transactional Data, January 2006 through December 2014

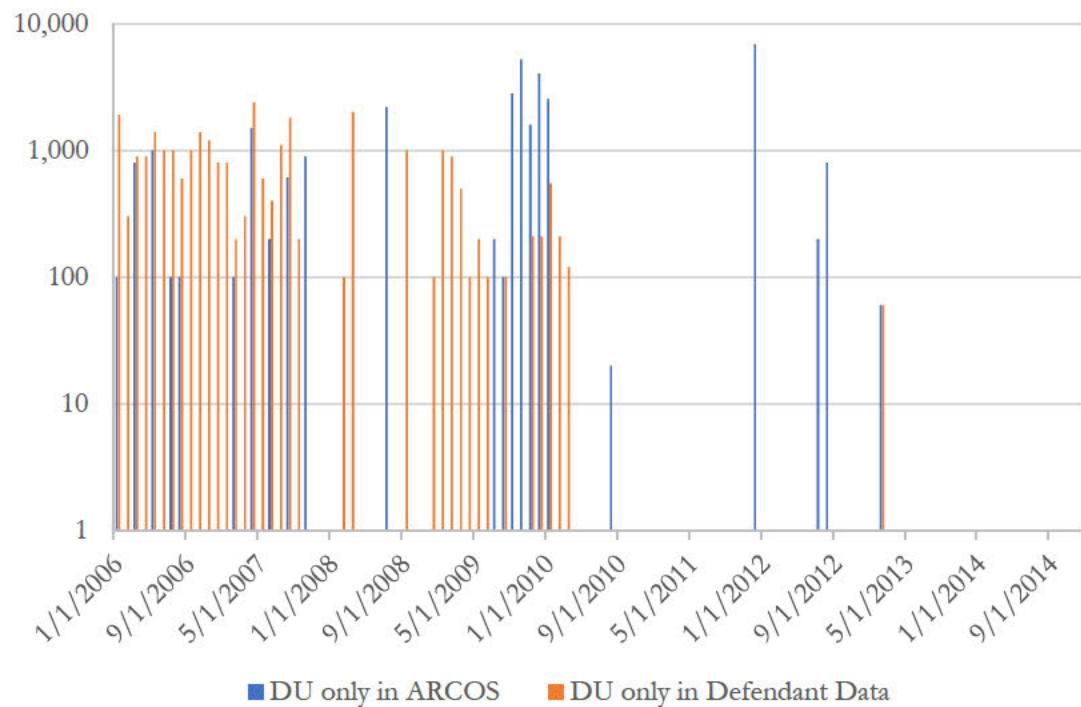


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<sup>36</sup> In AmerisourceBergen's Transactional Data there are 26 accounts numbers that share the common DEA Licenses AC2977556, BC3917436, and FM4902400. In ARCOS, the first DEA number belongs to Cabell Huntington Hospital (business activity Hospital/Clinic) and the second DEA number belongs to Cabell Huntington Outpatient Pharmacy (business activity as Retail Pharmacy). I cannot find the last DEA number in the ARCOS data I received.

95. Figure 5 shows the Dosage Units reported only in the ARCOS data and only in the AmerisourceBergen's Transactional Data in logarithm scale in Cabell County and the City of Huntington, WV.

Figure 5 Dosage Units Reported only in the ARCOS Data and only in the AmerisourceBergen's Transactional Data, January 2006 through December 2014



96. The comparison shows that nearly all the Dosage Units and MME in the AmerisourceBergen's Transactional Data (99.9%) are also found in ARCOS Data. See Table 23.

**Table 23 Comparison by Drug code in ARCOS Data vs. AmerisourceBergen's Transactional Data**

<b>Base Drug</b>	<b>Matched DU</b>		<b>Matched MME</b>		<b>Only in ARCOS</b>		<b>Only in Defendant Data</b>			
	<b>DU</b>	<b>MME</b>	<b>DU</b>	<b>%</b>	<b>MME</b>	<b>%</b>	<b>DU</b>	<b>%</b>	<b>MME</b>	<b>%</b>
9050	531,400	2,364,395	1400	0.26%	4973	0.21%	15500	2.92%	51716	2.19%
9064	306,328	123,555,616	2820	0.92%	601237	0.49%	1260	0.41%	129600	0.10%
9120	600	2,937	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9143	13,351,960	308,324,664	4700	0.04%	139428	0.05%	2700	0.02%	95477	0.03%
9150	302,820	15,120,338	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9193	23,739,520	112,794,610	20800	0.09%	107206	0.10%	7300	0.03%	29775	0.03%
9220	800	10,215	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9230	1,300	158,940	0	0.00%	22	0.01%	0	0.00%	0	0.00%
9250	1,586,100	74,913,996	1100	0.07%	64397	0.09%	100	0.01%	28621	0.04%
9300	1,069,244	39,864,028	600	0.06%	18297	0.05%	800	0.07%	28874	0.07%
9639	7,608	410,040	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9652	346,440	22,743,866	600	0.17%	40145	0.18%	0	0.00%	0	0.00%
9780	42,840	1,313,600	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9801	252,129	139,641,727	115	0.05%	49275	0.04%	10	0.00%	5000	0.00%
<b>Total</b>	<b>41,539,089</b>	<b>841,218,973</b>	<b>32,135</b>	<b>0.08%</b>	<b>1,024,980</b>	<b>0.12%</b>	<b>27,670</b>	<b>0.07%</b>	<b>369,063</b>	<b>0.04%</b>

97. Table 24 shows the Labelers of oxycodone and hydrocodone shipped by AmerisourceBergen to Cabell County and the City of Huntington, WV and the Labeler market shares in Dosage Units.

**Table 24 Labelers' Market Shares in AmerisourceBergen Oxycodone and Hydrocodone Shipments in Dosage Units, 2006-2014**

Labeler Name	Oxycodone	Hydrocodone	Total	%
Watson/Actavis/Allergan	4,024,000	17,924,000	21,948,000	59%
Mallinckrodt/SpecGx LLC	4,735,400	3,700,540	8,435,940	23%
Par Pharmaceutical	1,334,700	1,341,790	2,676,490	7%
Purdue	1,463,160	0	1,463,160	4%
Amneal	72,300	552,700	625,000	2%
Endo	586,400	0	586,400	2%
KVK-Tech, Inc.	285,700	0	285,700	1%
American Health Packaging	108,100	74,780	182,880	0%
Ethex Corporation	176,200	0	176,200	0%
Alvogen, Inc.	164,000	0	164,000	0%
UCB, Inc.	0	148,200	148,200	0%
Mylan Pharmaceuticals	114,200	0	114,200	0%
Teva	105,200	1,800	107,000	0%
West-Ward	104,600	0	104,600	0%
Sun Pharmaceutical	78,300	7,700	86,000	0%
McKesson Corporation	0	34,950	34,950	0%
Major Pharmaceuticals	0	33,500	33,500	0%
Abbott/AbbVie	0	29,900	29,900	0%
Forest Laboratories	0	27,300	27,300	0%
Hawthorn Pharmaceuticals	0	1,900	1,900	0%
Other Labelers	111,400	20,880	132,280	0%
<b>Total</b>	<b>13,463,660</b>	<b>23,899,940</b>	<b>37,363,600</b>	<b>100%</b>

98. Table 25 lists the Dispensers that AmerisourceBergen shipped oxycodone and hydrocodone to in Cabell County and the City of Huntington, WV.

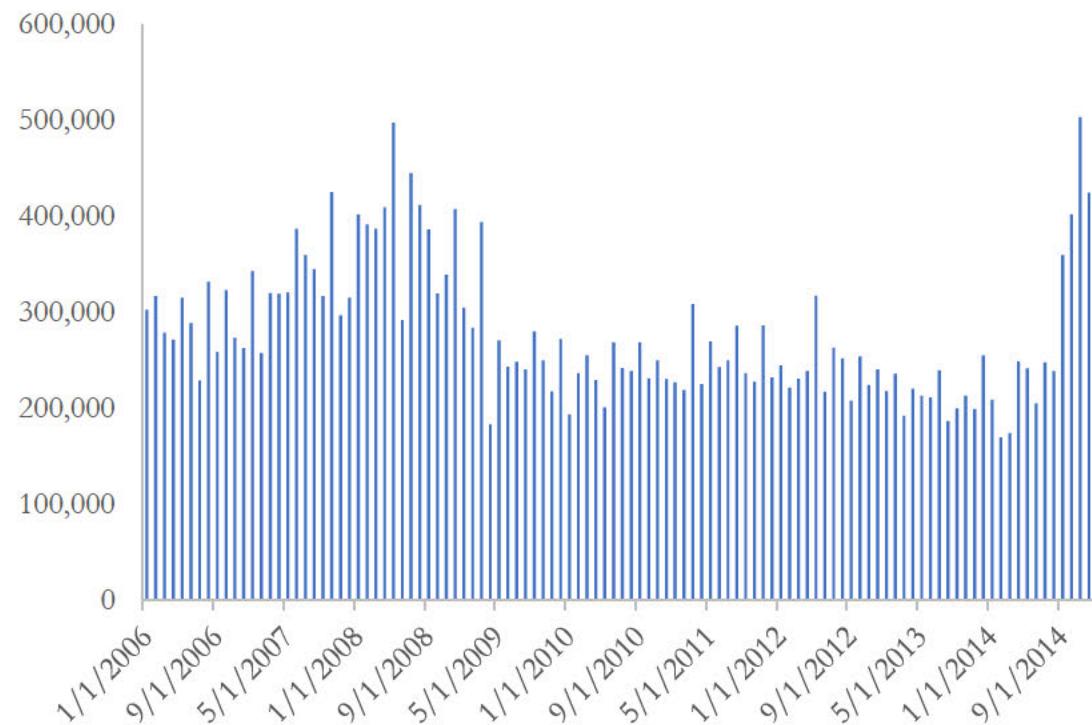
Table 25 AmerisourceBergen Oxycodone and Hydrocodone Shipments to Dispensers in Dosage Units, 2006-2014

Dispenser Name	Oxycodone	Hydrocodone	Total	%
Walgreen Co	315,200	321,680	636,880	2%
Other Chain Pharmacy	0	0	0	0%
<b>Chain Pharmacy Total</b>	<b>315,200</b>	<b>321,680</b>	<b>636,880</b>	<b>2%</b>
Retail Pharmacy	10,159,340	17,833,920	27,993,260	75%
Closed Door Pharmacy	1,073,300	3,747,960	4,821,260	13%
Mail Order Pharmacy	264,400	7,000	271,400	1%
Other Dispensers	1,651,420	1,989,380	3,640,800	10%
<b>Grand Total</b>	<b>13,463,660</b>	<b>23,899,940</b>	<b>37,363,600</b>	<b>100%</b>

*3. McKesson Corporation*

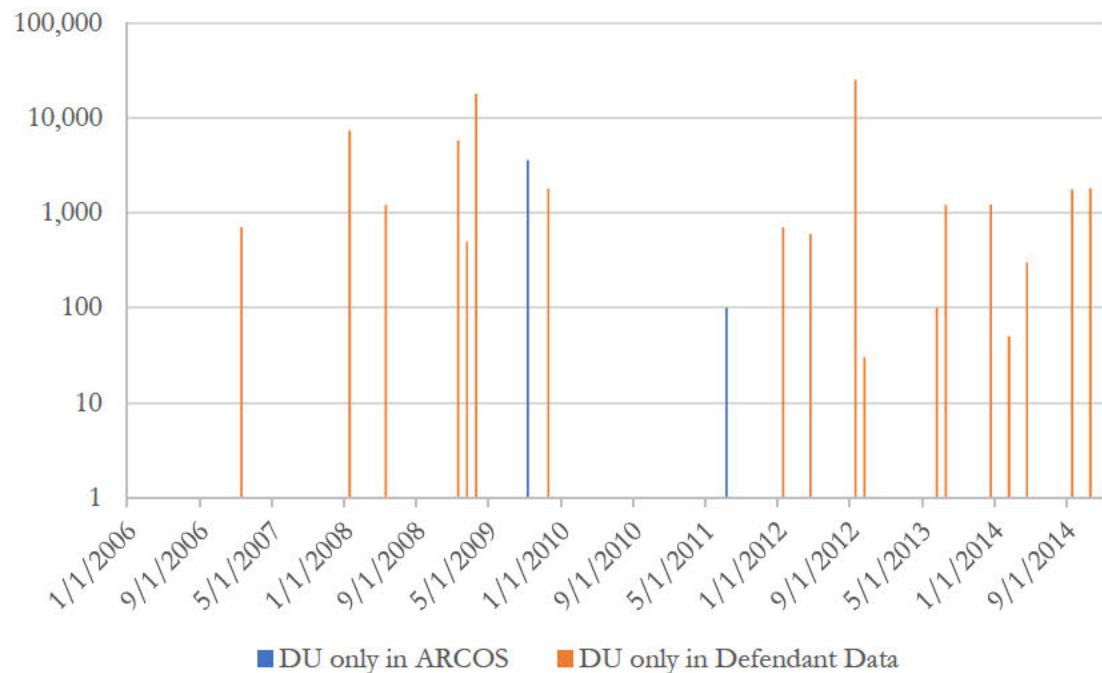
99. Figure 6 shows the matched Dosage Units reported each month in the ARCOS Data and in McKesson's Transactional Data in Cabell County and the City of Huntington, WV.

Figure 6 Dosage Units Reported in the ARCOS Data or McKesson's Transactional Data, January 2006 through December 2014



100. Figure 7 shows the Dosage Units reported only in the ARCOS data and only in the McKesson's Transactional Data in logarithm scale in Cabell County and the City of Huntington, WV.

Figure 7 Dosage Units Reported only in the ARCOS Data and only in the McKesson's Transactional Data, January 2006 through December 2014



101. The comparison shows that nearly all the Dosage Units and MME in the McKesson's Transactional Data (99.8%) are also found in transactions in ARCOS. See Table 26.

**Table 26 Comparison by Drug code in ARCOS Data vs. McKesson's Transactional Data**

<b>Base Drug</b>	<b>Matched DU</b>		<b>Matched MME</b>		<b>Only in ARCOS</b>			<b>Only in Defendant Data</b>		
	<b>DU</b>	<b>MME</b>	<b>DU</b>	<b>%</b>	<b>MME</b>	<b>%</b>	<b>DU</b>	<b>%</b>	<b>MME</b>	<b>%</b>
9050	515,200	2,108,182	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9064	340,896	137,719,224	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9120	500	2,098	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9143	15,654,640	154,870,219	3600	0.02%	24206	0.02%	35500	0.23%	296181	0.19%
9150	355,990	6,259,751	0	0.00%	709	0.01%	0	0.00%	2979	0.05%
9193	8,109,640	35,031,767	0	0.00%	0	0.00%	16260	0.20%	56332	0.16%
9220	200	2,554	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9230	11,300	58,913	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9250	1,356,900	48,055,486	0	0.00%	0	0.00%	7700	0.57%	275475	0.57%
9300	3,526,019	94,315,277	0	0.00%	0	0.00%	8200	0.23%	198423	0.21%
9639	1,824	102,240	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9652	84,560	4,721,662	0	0.00%	0	0.00%	0	0.00%	0	0.00%
9780	26,840	828,200	100	0.37%	4000	0.48%	0	0.00%	0	0.00%
9801	186,847	117,323,807	0	0.00%	0	0.00%	205	0.11%	128110	0.11%
<b>Total</b>	<b>30,171,356</b>	<b>601,399,381</b>	<b>3,700</b>	<b>0.01%</b>	<b>28,915</b>	<b>0.00%</b>	<b>67,865</b>	<b>0.22%</b>	<b>957,501</b>	<b>0.16%</b>

102. Table 27 shows the Labelers of oxycodone and hydrocodone shipped by McKesson to Cabell County and the City of Huntington, WV and Labeler market shares in Dosage Units.

**Table 27 Labelers' Market Shares in McKesson Oxycodone and Hydrocodone Shipments in Dosage Units, 2006-2014**

<b>Labeler Name</b>	<b>Oxycodone</b>	<b>Hydrocodone</b>	<b>Total</b>	<b>%</b>
Mallinckrodt/SpecGx LLC	11,232,900	5,875,460	17,108,360	74%
Par Pharmaceutical	1,983,100	1,390,630	3,373,730	15%
Watson/Actavis/Allergan	576,700	491,000	1,067,700	5%
West-Ward	547,000	0	547,000	2%
Amneal	252,900	46,300	299,200	1%
Purdue	224,240	0	224,240	1%
Ethex Corporation	175,000	0	175,000	1%
Mylan Pharmaceuticals	101,000	0	101,000	0%
KVK-Tech, Inc.	50,000	0	50,000	0%
Teva	24,900	11,800	36,700	0%
Endo	17,400	0	17,400	0%
Sun Pharmaceutical	14,200	1,400	15,600	0%
Alvogen, Inc.	14,700	0	14,700	0%
Hawthorn Pharmaceuticals	0	12,900	12,900	0%
UCB, Inc.	0	6,600	6,600	0%
Abbott/AbbVie	0	4,500	4,500	0%
McKesson Corporation	0	3,400	3,400	0%
Forest Laboratories	0	1,500	1,500	0%
Major Pharmaceuticals	0	1,300	1,300	0%
American Health Packaging	200	0	200	0%
Other Labelers	69,500	23,180	92,680	0%
<b>Total</b>	<b>15,283,740</b>	<b>7,869,970</b>	<b>23,153,710</b>	<b>100%</b>

103. Table 28 lists the Dispensers that McKesson shipped oxycodone and hydrocodone to in Cabell County and the City of Huntington, WV.

**Table 28 McKesson Oxycodone and Hydrocodone Shipments to Dispensers in Dosage Units, 2006-2014**

Dispenser Name	Oxycodone	Hydrocodone	Total	%
Rite Aid	2,396,440	843,040	3,239,480	14%
Target Stores	140,800	500,270	641,070	3%
Wal-Mart	21,300	143,860	165,160	1%
Kroger	0	3,800	3,800	0%
Walgreen Co	0	3,000	3,000	0%
Other Chain Pharmacy	0	0	0	0%
<b>Chain Pharmacy Total</b>	<b>2,558,540</b>	<b>1,493,970</b>	<b>4,052,510</b>	<b>18%</b>
Retail Pharmacy	305,320	141,730	447,050	2%
Closed Door Pharmacy	187,400	560,200	747,600	3%
Mail Order Pharmacy	154,300	500	154,800	1%
Other Dispensers	12,078,180	5,673,570	17,751,750	77%
<b>Grand Total</b>	<b>15,283,740</b>	<b>7,869,970</b>	<b>23,153,710</b>	<b>100%</b>

## **VII. Flagged Distributor Defendants Transactions**

104. I implemented various approaches to identify transactions meeting specified criteria using the non-public ARCOS Data from 2006 to 2014, supplemented with Defendants' Transactional Data where the ARCOS Data is obviously missing but are included in the transactions produced by Distributor Defendants in discovery and to the extent I have Defendants' Transactional Data for the periods before 2006 and after 2014. I calculated the results separately for each of twelve controlled substance drug codes.<sup>37</sup>

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<sup>37</sup> I do not analyze transactions in two treatment drugs: buprenorphine and methadone.

**A. Method 1: Maximum Monthly, Trailing Six-month Threshold**

105. Under the first approach, I identify transactions that cause the number of Dosage Units shipped by a Distributor Defendant to a pharmacy in a calendar month to exceed the highest number of Dosage Units shipped by the Distributor Defendant to the pharmacy in any one of the six preceding calendar months.<sup>38</sup> For example, if the number of Dosage Units containing hydrocodone shipped from a Distributor Defendant to a pharmacy in February, March, April, May, June, and July was 5,000; 10,000; 7,000; 8,000; 9,000; and 9,500 respectively, a requested transaction in August would be flagged if it would cause the number of Dosage Units containing hydrocodone the Distributor Defendant shipped to the pharmacy to exceed 10,000. Any reported transactions containing hydrocodone on that date and all reported transactions containing hydrocodone from that Distributor Defendant to that pharmacy thereafter are flagged.

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<sup>38</sup> In this approach and the others implemented below (with the exception of Method 2: Trailing Six-month Maximum Monthly, Fixed After First Triggered Threshold) my calculation is based on the entire shipment of this Distributor Defendants, not of individual Distribution Center.

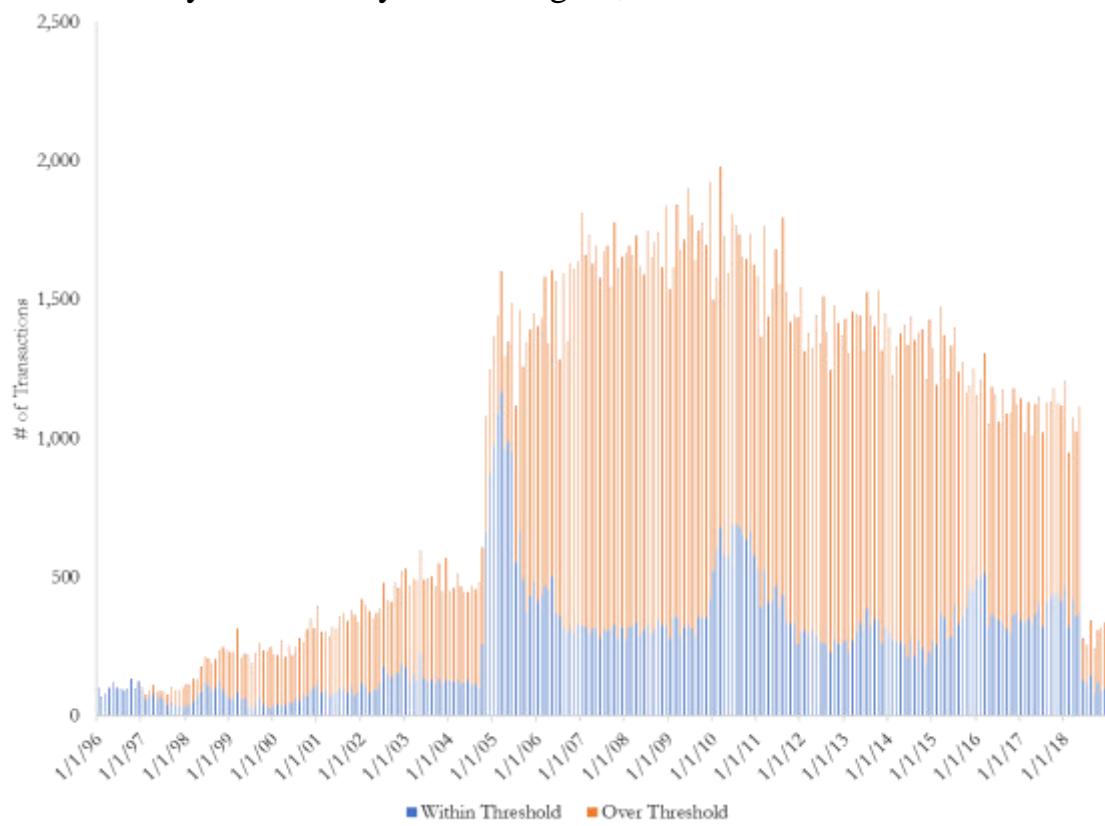
106. Table 29 reports Total MME and % of Total MME in transactions flagged in Cabell County and the City of Huntington, WV using the Trailing Six-Month Maximum Threshold.

Table 29 Trailing Six-Month Maximum Threshold Flagged Transactions, Cabell County and the City of Huntington, WV, Total MME and % MME

<b>Year</b>	<b>Defendants' Total MME</b>	<b>Flagged MME</b>	<b>%</b>
1996	3,676,079	3,420	0.1%
1997	2,971,440	1,593,871	53.6%
1998	5,628,469	2,903,431	51.6%
1999	9,748,424	7,090,993	72.7%
2000	13,277,798	10,055,886	75.7%
2001	16,011,946	11,090,098	69.3%
2002	20,776,512	13,782,638	66.3%
2003	24,095,532	16,775,991	69.6%
2004	33,812,841	16,742,681	49.5%
2005	88,976,826	36,047,335	40.5%
2006	101,663,192	75,807,024	74.6%
2007	106,658,684	83,086,310	77.9%
2008	113,665,454	86,871,826	76.4%
2009	128,134,351	101,592,902	79.3%
2010	134,446,855	88,948,942	66.2%
2011	123,822,352	95,754,631	77.3%
2012	98,917,207	78,017,593	78.9%
2013	86,041,530	62,996,586	73.2%
2014	88,675,236	67,936,969	76.6%
2015	88,769,151	63,922,004	72.0%
2016	68,217,935	45,441,503	66.6%
2017	49,205,864	32,127,807	65.3%
2018	24,161,252	14,767,536	61.1%
<b>Total</b>	<b>1,431,354,928</b>	<b>1,013,357,980</b>	<b>70.8%</b>

107. Figure 8 illustrates total opioid transactions from Distributor Defendants to retail and chain pharmacies into Cabell County and the City of Huntington, WV from 1996 to 2018 and those transactions which would be flagged by the Trailing Six-Month Maximum Threshold methodology. The Trailing Six-Month Maximum Threshold methodology flags 71.9% of transactions accounting for 87.0% of Dosage Units, 70.8% of MME and 85.0% of drug weight shipped into Cabell County and the City of Huntington, WV. Additional charts and tables reflecting the result of applying this methodology and the methodologies below to each Distributor Defendant are in Appendix 7.

Figure 8 Trailing Six-Month Maximum Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018



108. Table 30 summarizes the transactions flagged based on the Trailing Six-Month Maximum Threshold Approach in Cabell County and the City of Huntington, WV.

Table 30 Trailing Six-Month Maximum Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen Drug	28,821	39,960	6,080	363	2,175	3,493	<b>80,892</b>
Cardinal Health	47,104	31,744	8,824	1,263	2,273	4,059	<b>95,267</b>
McKesson Corporation	7,900	7,188	953	35	225	323	<b>16,624</b>
<b>Total</b>	<b>83,825</b>	<b>78,892</b>	<b>15,857</b>	<b>1,661</b>	<b>4,673</b>	<b>7,875</b>	<b>192,783</b>

#### **B. Method 2: Trailing Six-month Maximum Monthly, Fixed After First Triggered Threshold**

109. Under the second approach, when a transaction causes the number of dosage units shipped to a pharmacy in a month to exceed the highest number of dosage units shipped to the pharmacy in any one of the six preceding months, the dosage units of highest month in the preceding six months becomes threshold which is then applied in all subsequent months. For example, if the number of Dosage Units containing hydrocodone shipped from a Distributor Defendant to a pharmacy in February, March, April, May, June, and July was 5,000; 10,000; 7,000; 8,000; 9,000; and 9,500 respectively, a requested transaction in August would be flagged if it would cause the number of Dosage Units containing hydrocodone the Distributor Defendant shipped to the Pharmacy to exceed 10,000. Any reported transactions containing hydrocodone on that date and to the month-end from that

Distributor Defendant to that pharmacy are flagged. This 10,000 Dosage Units number becomes the fixed monthly hydrocodone limit of this pharmacy thereafter and the excess, if any, of the pharmacy's monthly receipt in excess of 10,000 is flagged.

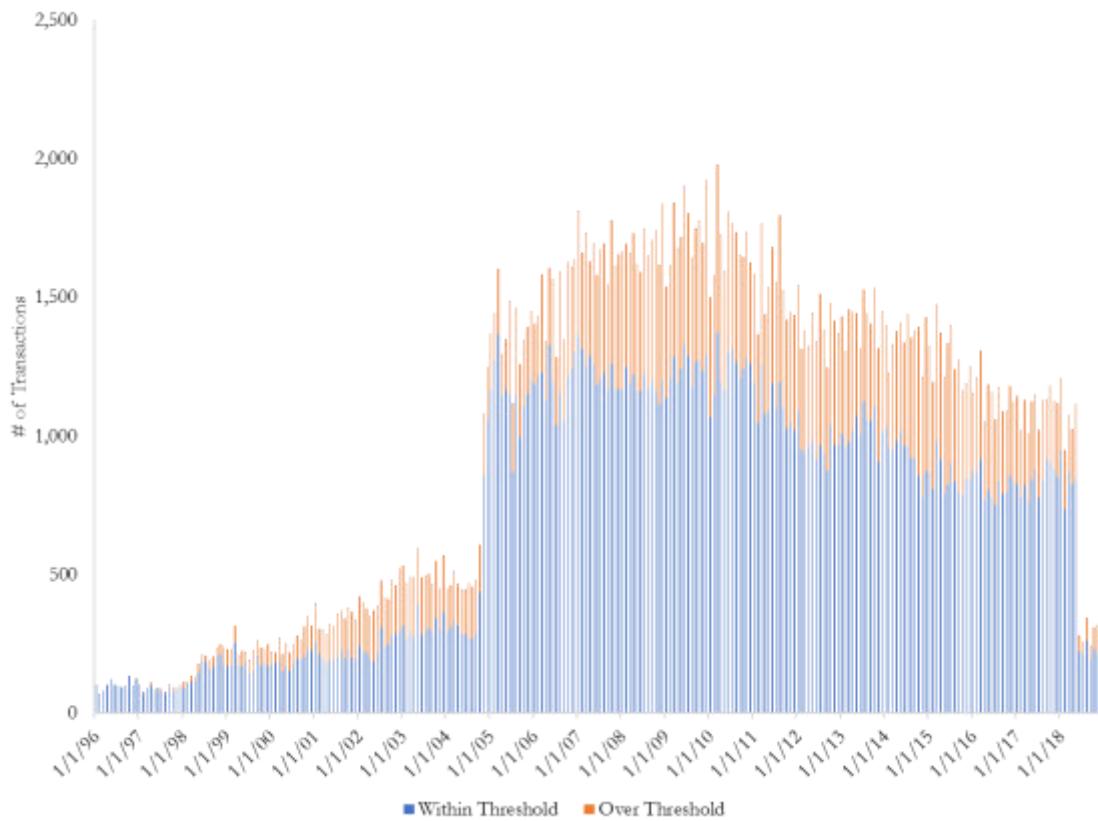
110. Table 31 reports Total MME and % of Total MME in transactions flagged in Cabell County and the City of Huntington, WV using the Trailing Six-Month Maximum, Fixed After Triggered Threshold.

Table 31 Trailing Six-Month Maximum, Fixed After Triggered Threshold Flagged Transactions, Cabell County and the City of Huntington, WV, Total MME and % MME

<b>Year</b>	<b>Defendants' Total MME</b>	<b>Flagged MME</b>	<b>%</b>
1996	3,676,079	3,420	0.1%
1997	2,971,440	312,675	10.5%
1998	5,628,469	997,240	17.7%
1999	9,748,424	2,731,685	28.0%
2000	13,277,798	5,514,927	41.5%
2001	16,011,946	7,606,045	47.5%
2002	20,776,512	10,267,103	49.4%
2003	24,095,532	11,100,720	46.1%
2004	33,812,841	10,324,445	30.5%
2005	88,976,826	17,192,783	19.3%
2006	101,663,192	23,371,988	23.0%
2007	106,658,684	28,493,906	26.7%
2008	113,665,454	33,981,741	29.9%
2009	128,134,351	41,690,495	32.5%
2010	134,446,855	43,889,971	32.6%
2011	123,822,352	43,667,286	35.3%
2012	98,917,207	43,727,403	44.2%
2013	86,041,530	29,570,696	34.4%
2014	88,675,236	32,701,298	36.9%
2015	88,769,151	33,657,518	37.9%
2016	68,217,935	21,249,246	31.1%
2017	49,205,864	13,490,556	27.4%
2018	24,161,252	5,795,757	24.0%
<b>Total</b>	<b>1,431,354,928</b>	<b>461,338,903</b>	<b>32.2%</b>

111. Figure 9 illustrates total opioid transactions from Distributor Defendants to retail and chain pharmacies into Cabell County and the City of Huntington, WV from 1996 to 2018 and those transactions which would be flagged by the Trailing Six-Month Maximum, Fixed After Triggered Threshold methodology. The Trailing Six-Month Maximum, Fixed After Triggered Threshold methodology flags 27.6% of transactions accounting for 37.7% of Dosage Units, 32.2% of MME and 37.2% of drug weight shipped into Cabell County and the City of Huntington, WV.

Figure 9 Trailing Six-Month Maximum, Fixed After Triggered Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018



112. Table 32 summarizes the transactions flagged based on the Trailing Six-Month Maximum, Fixed After Triggered Threshold Approach in Cabell County and the City of Huntington, WV.

Table 32 Trailing Six-Month Maximum, Fixed After Triggered Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen Drug	9,322	8,668	1,284	22	930	289	<b>20,515</b>
Cardinal Health	32,413	13,121	1,958	32	820	238	<b>48,582</b>
McKesson Corporation	1,486	3,318	56	2	18	37	<b>4,917</b>
<b>Total</b>	<b>43,221</b>	<b>25,107</b>	<b>3,298</b>	<b>56</b>	<b>1,768</b>	<b>564</b>	<b>74,014</b>

### C. Method 3: Twice Trailing Twelve-Month Average Pharmacy Dosage Units

113. Under the third approach, I identify transactions that cause the number of Dosage Units shipped by a Distributor Defendant to a pharmacy in a calendar month to exceed twice the trailing twelve-month average Dosage Units to retail and chain pharmacies served by the Distributor Defendant.

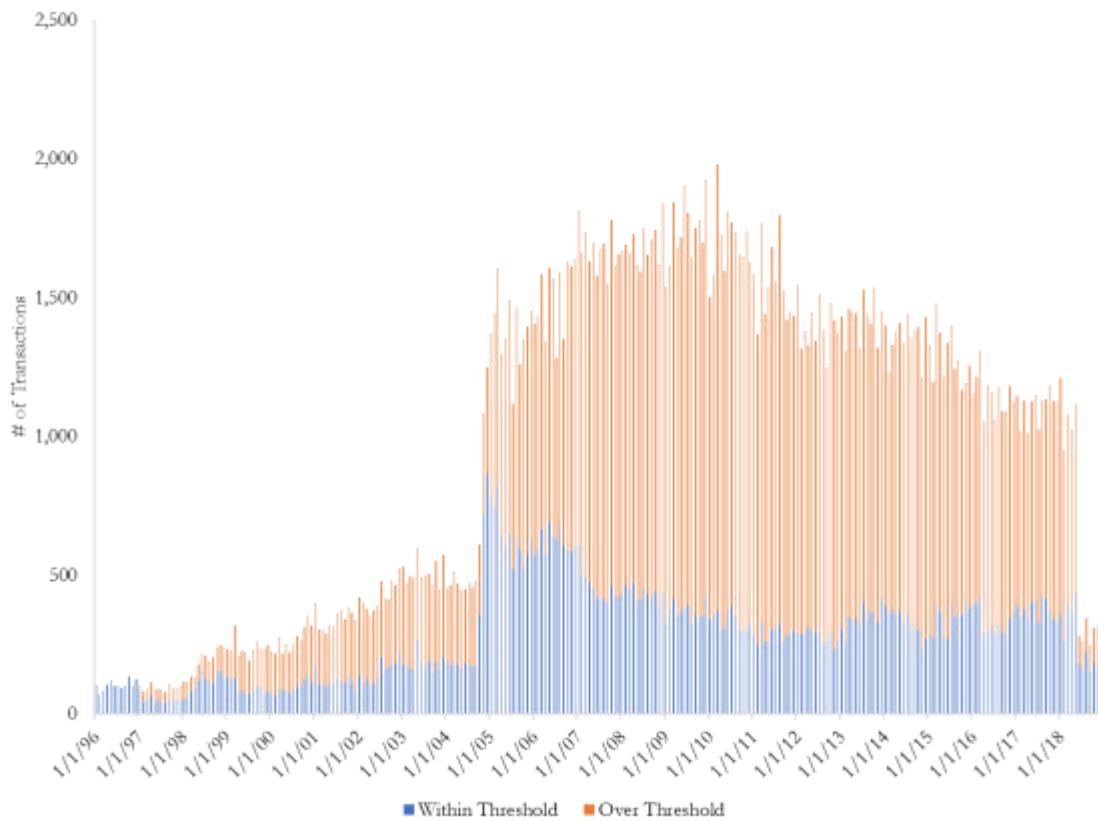
114. Table 33 reports Total MME and % of Total MME in transactions flagged in Cabell County and the City of Huntington, WV using the Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold.

Table 33 Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Cabell County and the City of Huntington, WV, Total MME and % MME

<b>Year</b>	<b>Defendants' Total MME</b>	<b>Flagged MME</b>	<b>%</b>
1996	3,676,079	0	0.0%
1997	2,971,440	2,362,764	79.5%
1998	5,628,469	3,595,390	63.9%
1999	9,748,424	8,066,810	82.7%
2000	13,277,798	10,895,447	82.1%
2001	16,011,946	12,605,642	78.7%
2002	20,776,512	14,929,318	71.9%
2003	24,095,532	16,752,464	69.5%
2004	33,812,841	20,446,643	60.5%
2005	88,976,826	59,408,863	66.8%
2006	101,663,192	72,870,255	71.7%
2007	106,658,684	87,189,516	81.7%
2008	113,665,454	92,792,677	81.6%
2009	128,134,351	110,223,308	86.0%
2010	134,446,855	115,372,460	85.8%
2011	123,822,352	110,624,242	89.3%
2012	98,917,207	86,615,737	87.6%
2013	86,041,530	70,990,924	82.5%
2014	88,675,236	74,371,152	83.9%
2015	88,769,151	71,245,074	80.3%
2016	68,217,935	52,268,956	76.6%
2017	49,205,864	35,537,464	72.2%
2018	24,256,687	14,910,444	61.7%
<b>Total</b>	<b>1,431,450,363</b>	<b>1,144,075,550</b>	<b>79.9%</b>

115. Figure 10 illustrates total opioid transactions from Distributor Defendants to retail and chain pharmacies into Cabell County and the City of Huntington, WV from 1996 to 2018 and those transactions which would be flagged by the Twice Trailing Twelve-month Average Pharmacy Dosage Units methodology. The Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold methodology flags 70.5% of transactions accounting for 81.5% of Dosage Units, 79.9% of MME and 80.7% of drug weight shipped into Cabell County and the City of Huntington, WV.

Figure 10 Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018



116. Table 34 summarizes the transactions flagged based on the Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold in Cabell County and the City of Huntington, WV.

Table 34 Twice Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen Drug	23,363	35,026	4,422	746	2,566	7,340	<b>73,463</b>
Cardinal Health	39,553	33,354	8,576	1,693	3,096	17,819	<b>104,091</b>
McKesson Corporation	4,802	3,521	414	48	620	1,843	<b>11,248</b>
<b>Total</b>	<b>67,718</b>	<b>71,901</b>	<b>13,412</b>	<b>2,487</b>	<b>6,282</b>	<b>27,002</b>	<b>188,802</b>

#### **D. Method 4: Three Times Trailing Twelve-Month Average Pharmacy Dosage Units**

117. Under the fourth approach, I identify transactions that cause the number of Dosage Units shipped by a Distributor Defendant to a pharmacy in a calendar month to exceed three times the trailing twelve-month average Dosage Units to retail and chain pharmacies served by the Distributor Defendant.

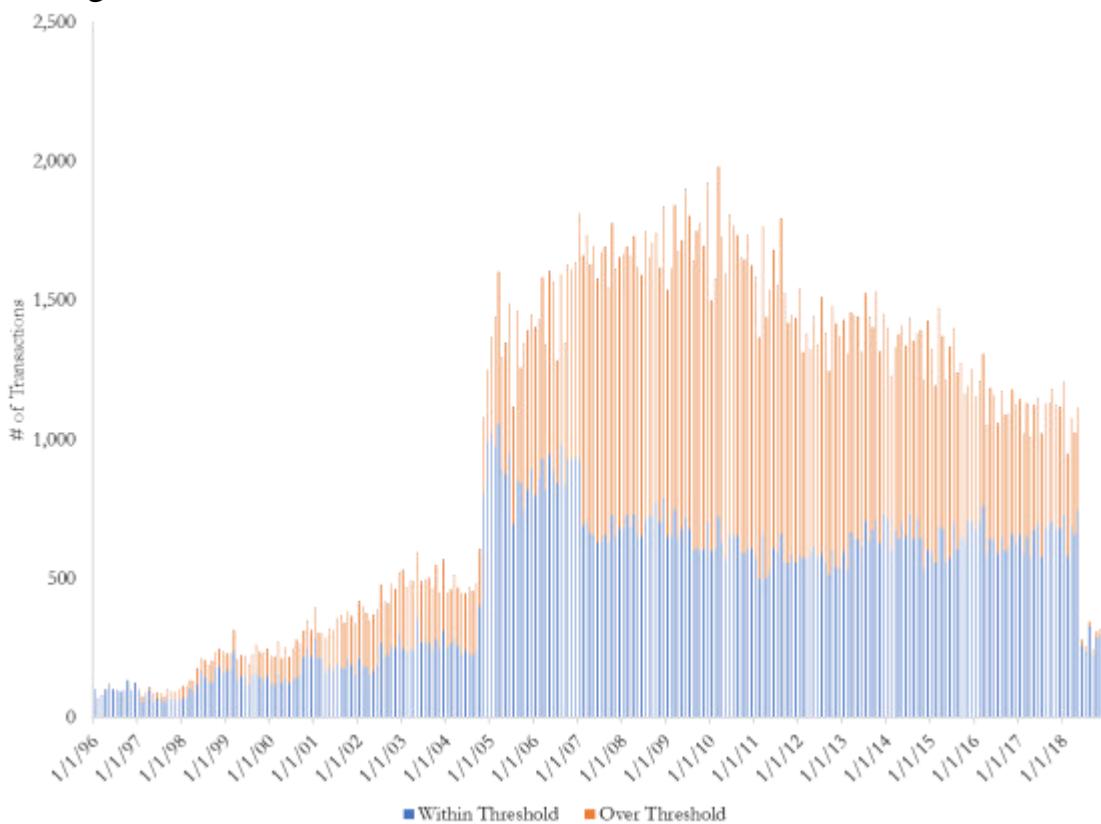
118. Table 35 reports Total MME and % of Total MME in transactions flagged in Cabell County and the City of Huntington, WV using the Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold.

Table 35 Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Cabell County and the City of Huntington, WV, Total MME and % MME

<b>Year</b>	<b>Defendants' Total MME</b>	<b>Flagged MME</b>	<b>%</b>
1996	3,676,079	0	0.0%
1997	2,971,440	2,047,426	68.9%
1998	5,628,469	3,105,597	55.2%
1999	9,748,424	6,189,206	63.5%
2000	13,277,798	9,170,847	69.1%
2001	16,011,946	10,202,920	63.7%
2002	20,776,512	13,154,352	63.3%
2003	24,095,532	14,075,836	58.4%
2004	33,812,841	17,308,963	51.2%
2005	88,976,826	43,529,339	48.9%
2006	101,663,192	51,470,923	50.6%
2007	106,658,684	72,005,547	67.5%
2008	113,665,454	75,272,916	66.2%
2009	128,134,351	89,607,725	69.9%
2010	134,446,855	95,224,357	70.8%
2011	123,822,352	94,590,943	76.4%
2012	98,917,207	68,093,595	68.8%
2013	86,041,530	50,535,583	58.7%
2014	88,675,236	49,750,851	56.1%
2015	88,769,151	47,351,026	53.3%
2016	68,217,935	32,428,136	47.5%
2017	49,205,864	22,093,552	44.9%
2018	24,256,687	7,733,058	31.9%
<b>Total</b>	<b>1,431,450,363</b>	<b>874,942,698</b>	<b>61.1%</b>

119. Figure 11 illustrates total opioid transactions from Distributor Defendants to retail and chain pharmacies into Cabell County and the City of Huntington, WV from 1996 to 2018 and those transactions which would be flagged by the Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold methodology. The Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold methodology flags 50.9% of transactions accounting for 63.6% of Dosage Units, 61.1% of MME and 62.5% of drug weight shipped into Cabell County and the City of Huntington, WV.

Figure 11 Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018



120. Table 36 summarizes the transactions flagged based on the Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold in Cabell County and the City of Huntington, WV.

Table 36 Three Times Trailing Twelve-Month Average Pharmacy Dosage Units Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen Drug	17,165	28,049	2,226	247	2,210	3,904	<b>53,801</b>
Cardinal Health	25,932	28,187	6,978	736	2,314	13,915	<b>78,062</b>
McKesson Corporation	1,989	1,285	30	0	308	954	<b>4,566</b>
<b>Total</b>	<b>45,086</b>	<b>57,521</b>	<b>9,234</b>	<b>983</b>	<b>4,832</b>	<b>18,773</b>	<b>136,429</b>

#### E. Method 5: Maximum 8,000 Dosage Units Monthly

121. Under the fifth approach, I identify transactions that cause the number of Dosage Units shipped by a Distributor Defendant to a pharmacy in a calendar month to exceed 8,000 Dosage Units.<sup>39</sup>

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<sup>39</sup> McKesson Operations Manual for Pharma Distribution dated May 16, 2007 shows the dosage threshold of 8,000 on oxycodone or hydrocodone (MCK-WVAG-003-0001047, MCKMDL00355251).

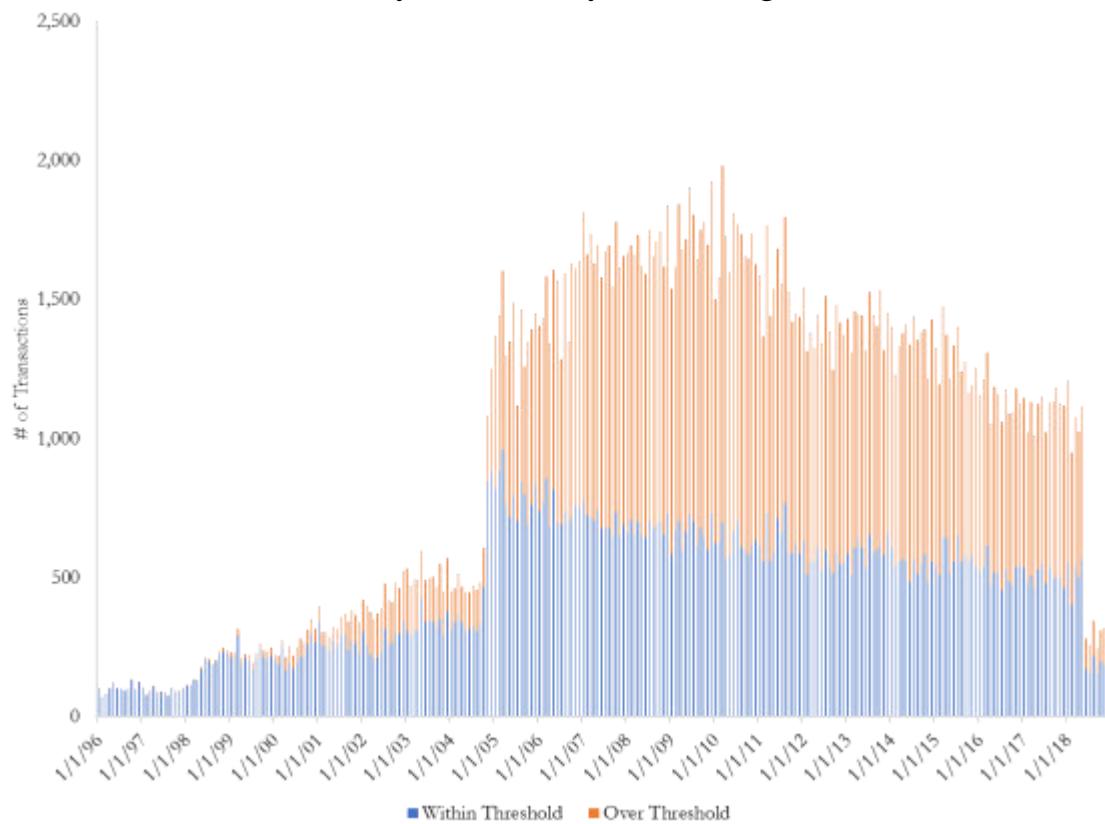
122. Table 37 reports Total MME and % of Total MME in transactions flagged in Cabell County and the City of Huntington, WV using the Maximum 8,000 Dosage Units Monthly Threshold.

Table 37 Maximum 8,000 Dosage Units Monthly Threshold Flagged Transactions, Cabell County and the City of Huntington, WV, Total MME and % MME

<b>Year</b>	<b>Defendants' Total MME</b>	<b>Flagged MME</b>	<b>%</b>
1996	3,676,079	82,531	2.2%
1997	2,971,440	57,668	1.9%
1998	5,628,469	137,467	2.4%
1999	9,748,424	2,107,662	21.6%
2000	13,277,798	3,246,199	24.4%
2001	16,011,946	4,139,172	25.9%
2002	20,776,512	8,376,490	40.3%
2003	24,095,532	9,361,409	38.9%
2004	33,812,841	11,460,331	33.9%
2005	88,976,826	42,778,692	48.1%
2006	101,663,192	56,120,423	55.2%
2007	106,658,684	63,593,810	59.6%
2008	113,665,454	67,861,342	59.7%
2009	128,134,351	83,984,882	65.5%
2010	134,446,855	86,737,762	64.5%
2011	123,822,352	76,330,784	61.6%
2012	98,917,207	62,738,809	63.4%
2013	86,041,530	49,967,716	58.1%
2014	88,675,236	54,842,075	61.8%
2015	88,769,151	56,247,880	63.4%
2016	68,217,935	41,881,116	61.4%
2017	49,205,864	28,280,472	57.5%
2018	24,256,687	12,406,513	51.1%
<b>Total</b>	<b>1,431,450,363</b>	<b>822,741,206</b>	<b>57.5%</b>

123. Figure 12 illustrates total opioid transactions from Distributor Defendants to retail and chain pharmacies into Cabell County and the City of Huntington, WV from 1996 to 2018 and those transactions which would be flagged by the Maximum 8,000 Dosage Units Monthly Threshold methodology. The Maximum 8,000 Dosage Units Monthly Threshold methodology flags 52.7% of transactions accounting for 78.0% of Dosage Units, 57.5% of MME and 68.4% of drug weight shipped into Cabell County and the City of Huntington, WV.

Figure 12 Maximum 8,000 Dosage Units Monthly Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018



124. Table 38 summarizes the transactions flagged based on the Maximum 8,000 Dosage Units Monthly Threshold Approach in Cabell County and the City of Huntington, WV.

Table 38 Maximum 8,000 Dosage Units Monthly Threshold Flagged Transactions, Cabell County and the City of Huntington, WV 1996 to 2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen Drug	23,006	41,230	0	0	635	0	<b>64,871</b>
Cardinal Health	37,293	29,845	0	0	0	957	<b>68,095</b>
McKesson Corporation	4,294	3,858	0	0	0	0	<b>8,152</b>
<b>Total</b>	<b>64,593</b>	<b>74,933</b>	<b>0</b>	<b>0</b>	<b>635</b>	<b>957</b>	<b>141,118</b>

#### F. Method 6: Maximum Daily Dosage Units

125. Under the sixth approach, I identify transactions that cause the number of Dosage Units shipped by a Distributor Defendant to a pharmacy in a day to exceed a specified number of Dosage Units that varies by drug type and within some drug types by formulation.<sup>40</sup>

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<sup>40</sup> Maximum Daily Dosage Units used as specified in CAH\_MDLPRIORPRO\_DEA07\_01384160.

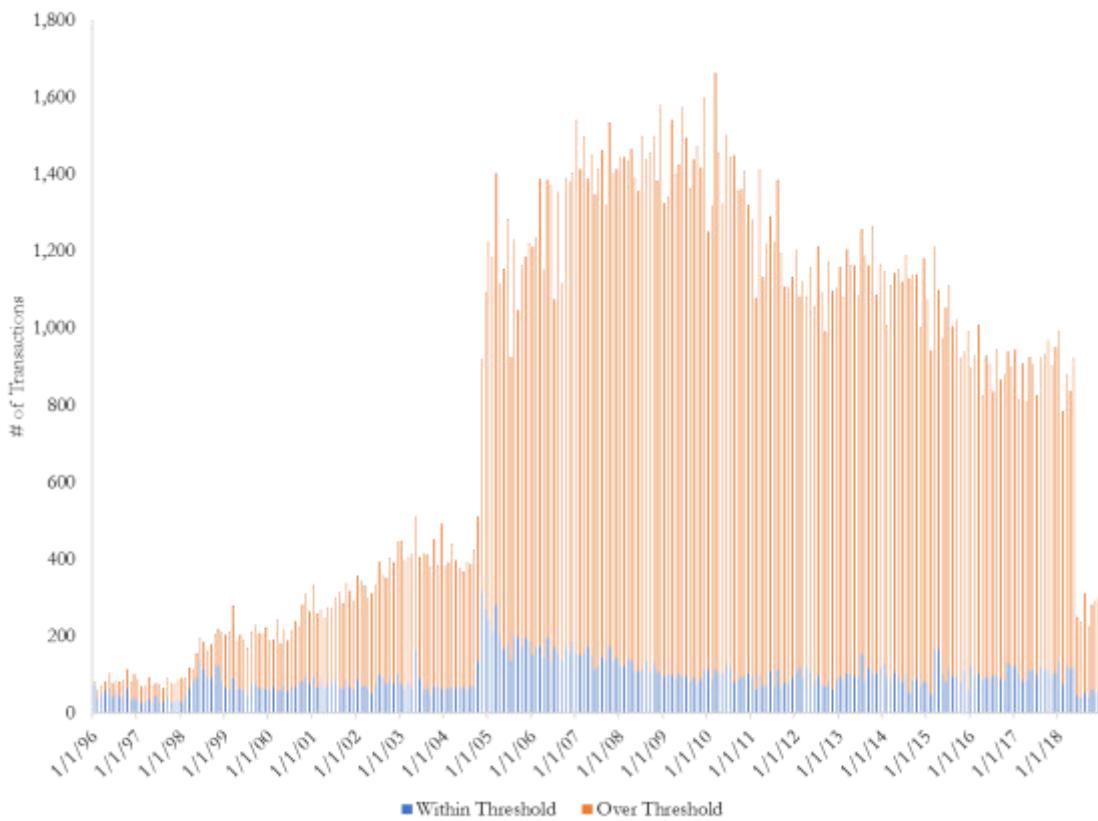
126. Table 39 reports Total MME and % of Total MME in transactions flagged in Cabell County and the City of Huntington, WV using the Maximum Daily Dosage Units Threshold.

Table 39 Maximum Daily Dosage Units Threshold Flagged Transactions, Cabell County and the City of Huntington, WV, Total MME and % MME

<b>Year</b>	<b>Defendants' Total MME</b>	<b>Flagged MME</b>	<b>%</b>
1996	2,519,961	1,574,927	62.5%
1997	2,413,289	2,104,427	87.2%
1998	4,222,541	2,823,792	66.9%
1999	7,826,526	6,504,370	83.1%
2000	10,487,500	8,981,926	85.6%
2001	11,927,688	10,214,757	85.6%
2002	15,376,605	13,946,810	90.7%
2003	17,556,749	16,313,422	92.9%
2004	24,014,632	21,346,116	88.9%
2005	67,920,944	63,805,660	93.9%
2006	78,868,523	75,081,191	95.2%
2007	81,618,726	78,656,011	96.4%
2008	86,711,380	84,412,142	97.3%
2009	100,055,902	98,287,999	98.2%
2010	101,300,482	98,876,182	97.6%
2011	88,085,792	86,813,965	98.6%
2012	71,590,543	69,902,950	97.6%
2013	63,136,525	61,230,957	97.0%
2014	66,036,736	64,073,295	97.0%
2015	67,531,414	65,620,692	97.2%
2016	50,460,085	48,684,671	96.5%
2017	35,801,386	34,469,580	96.3%
2018	18,755,215	17,385,450	92.7%
<b>Total</b>	<b>1,074,219,144</b>	<b>1,031,111,294</b>	<b>96.0%</b>

127. Figure 13 illustrates total opioid transactions from Distributor Defendants to retail and chain pharmacies into Cabell County and the City of Huntington, WV from 1996 to 2018 and those transactions which would be flagged by the Maximum Daily Dosage Units Threshold methodology. The Maximum Daily Dosage Units Threshold methodology flags 88.0% of transactions accounting for 96.1% of Dosage Units, 96.0% of MME and 93.1% of drug weight shipped into Cabell County and the City of Huntington, WV.

Figure 13 Maximum Daily Dosage Units Threshold, Any Order Subsequent to a Flagged Transaction, Cabell County and the City of Huntington, WV 1996 to 2018



128. Table 40 summarizes the transactions flagged based on the Maximum Daily Dosage Units Threshold Approach in Cabell County and the City of Huntington, WV.

Table 40 Maximum Daily Dosage Units Threshold Flagged Transactions in Cabell County and the City of Huntington, WV 1996 to 2018

# of Flagged Transactions	Oxycodone	Hydrocodone	Morphine	Hydromorphone	Oxymorphone	Other	Total
AmerisourceBergen Drug	30,063	43,951	5,601	1,059	n/a	724	<b>81,398</b>
Cardinal Health	47,440	37,183	8,936	1,395	n/a	2,092	<b>97,046</b>
McKesson Corporation	8,014	7,838	1,412	75	n/a	48	<b>17,387</b>
<b>Total</b>	<b>85,517</b>	<b>88,972</b>	<b>15,949</b>	<b>2,529</b>	n/a	<b>2,864</b>	<b>195,831</b>

### VIII. Charts and Reports

129. I have created additional Excel Macro and diagnostic tools, which allow the overlay of selected orders upon the ARCos data and/or Defendants' Transactional Data and provide the ability to sort, compare, and view the order history of an individual pharmacy. These macros and diagnostic tools are being provided with this report.

130. In Appendix 8 I have created a map illustrating the location of Cabell County (red) and the City of Huntington (yellow), along with the zip code 257\*\* and 255\*\* that covers the entire area.<sup>41</sup>

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<sup>41</sup> Source: [www.zeemaps.com](http://www.zeemaps.com)

131. In addition, I have created a set of Charts and Tables that are too voluminous to be displayed and discussed fully here-in. Those additional Charts and Tables are attached in Appendix 9 and Appendix 10, described generally in this section.

- **Appendix 9A: State Oxycodone and Hydrocodone MME Per Capita, 1997-2019**

132. Using ARCOS data produced by the DEA for 2006-2014 and public ARCOS Retail Drug Summary Reports otherwise, I plot total oxycodone and hydrocodone MME per capita, by State from 1997 to 2019. There is one chart and a 2-page backup summary table for oxycodone and hydrocodone.

133. In the two charts, the line reflecting West Virginia MME per capita is highlighted using red. The rest of the states are drawn in light grey.

134. The 2-page backup summary tables report oxycodone and hydrocodone MME per capita each year and averaged over the 1997-2019 period. The states are sorted by average MME per capita over the entire 23-year period.

- **Appendix 9B: Oxycodone and Hydrocodone Distribution by Distributor Defendant**

135. Using ARCOS data produced by the DEA for 2006-2014 and Distributor Defendants' Transactional Data for the periods before 2006 and after 2014, I plot all Distributor Defendants' shipments of oxycodone and hydrocodone into Cabell County and the City of Huntington, WV.

136. There are two versions of this chart. One version is a stacked bar chart in which the height of a colored section of each bar corresponds to

shipments by each Distributor Defendant according to the color-coded legend. The second version of the chart is a line graph in which each Distributor Defendant's shipments are reflected by the same color-coding as the stacked bar chart.

- **Appendix 9C: All Distributor Defendants Oxycodone and Hydrocodone Distribution**

137. Using ARCOS data produced by the DEA for 2006-2014 and Distributor Defendants' Transactional Data for the periods before 2006 and after 2014, I plot all Distributor Defendants' shipments of oxycodone and hydrocodone into Cabell County and the City of Huntington, WV from 1996 to 2018 in Dosage Units, MME and weight in milligram.

- **Appendix 9D: All Seller Oxycodone and Hydrocodone Distribution, by Zip Code and by Drug**

138. Using public ARCOS Retail Drug Summary Reports, I plot all shipments of oxycodone and hydrocodone into West Virginia and into all zip-codes in West Virginia from 1997 to 2019 in MME and weight in milligram.

139. ARCOS Retail Drug Summary Reports report State and 3-digit zip-code information. County boundaries do not coincide precisely with 3-digit zip-code boundaries. These charts - and any other chart, figure or analysis using ARCOS Retail Drug Summary Reports - use the 3-digit zip-codes.

- **Appendix 9E: Individual Distributor Defendant Oxycodone Distribution in Cabell County and the City of Huntington, WV, by Total Dosage, Total MME, Total Drug Base Weight**

140. Using ARCOS data produced by the DEA for 2006-2014 and Distributor Defendants' Transactional Data for the periods before 2006 and

after 2014, I plot each Distributor Defendants' monthly shipments of oxycodone into Cabell County and the City of Huntington, WV in Dosage Units, MME and base weight in milligram.

- **Appendix 9F: Individual Distributor Defendant Hydrocodone Distribution in Cabell County and the City of Huntington, WV, by Total Dosage, Total MME, Total Drug Base Weight**

141. Using ARCOS data produced by the DEA for 2006-2014 and Distributor Defendants' Transactional Data for the periods before 2006 and after 2014, I plot each Distributor Defendants' monthly shipments of hydrocodone into Cabell County and the City of Huntington, WV in Dosage Units, MME and base weight in milligram.

- **Appendix 9G: Oxycodone and Hydrocodone Distribution to Individual Pharmacies by All Distributors**

142. Using ARCOS data produced by the DEA for 2006-2014 and Distributor Defendants' Transactional Data for the periods before 2006 and after 2014, I plot all distributors' shipments of oxycodone and hydrocodone to each pharmacy that received oxycodone or hydrocodone from any of the Distributor Defendants in Cabell County and the City of Huntington, WV in Dosage Units, MME and base weight in milligram. Shipments made by non-defendant distributors are aggregated into the "Other" category.

- **Appendix 9H: Pharmacy Reports**

143. Using ARCOS data produced by the DEA for 2006-2014, I tabulate and report Dosage Units, MME and drug weight in milligram shipped to retail and chain pharmacies in Cabell County and the City of Huntington, WV. I list the pharmacies sorted by total MME. For each year, I report the

Dosage Units and drug weight in milligram of oxycodone and hydrocodone, and the Dosage Units and MME of the two drugs received by each pharmacy from each Distributor. For comparison purposes, I list the average pharmacy MME in the county and the state each year and each pharmacy's percentile rank by MME in the state each year.

- **Appendix 9I: Distributor Reports**

144. Using ARCOS data produced by the DEA for 2006-2014, I tabulate and report the total Dosage Units per capita by year and by state. I rank states by average Dosage Units per capita over the 2006-2014 period and plot the 25 states with the highest average Dosage Units per capita.

145. I tabulate and report the total MME per capita by year and by state and rank states by average MME per capita over the 2006-2014 period and plot the 25 states with the highest average MME per capita.

146. I tabulate and report the MME and Dosage Units each year and totaled over the 2006-2014 period and market shares over the 2006-2014 period for each Distributor. I further break down the Distributors' annual shipments and total shipments and market share over the 2006-2014 period into the Distributors' individual DEA numbers.

- **Appendix 9J: Oxycodone and Hydrocodone Distribution to Individual Pharmacies by Distributor Defendant**

147. Using ARCOS data for 2006-2014 and Distributor Defendants' Transactional Data for the periods before 2006 and after 2014, I plot shipments of oxycodone and hydrocodone to individual pharmacies by Distributor Defendant and by drug strength.

- **Appendix 9K: Oxycodone and Hydrocodone Distribution to Individual Pharmacies by Distribution Centers**

148. Using processed ARCos data for 2006-2014 and Distributor Defendants' Transactional Data before 2006 and after 2014, I plot Distributor Defendant Distributor Centers' monthly shipments of oxycodone and hydrocodone into individual pharmacies in Cabell County and the City of Huntington, WV. In the same chart, I also plot the state and national mean and median of the same-month shipment of all chain or retail pharmacies, depending on the business activity of this pharmacy.

- **Appendix 9L: Grouped Pharmacy Reports**

149. I tabulate and report defendant shipments of oxycodone and hydrocodone to 3 individual pharmacies and 5 groups of pharmacies in Cabell County and the City of Huntington, WV, including Drug Emporium, McCloud Family Pharmacy, SafeScript Pharmacy, four CVS stores, four Fruth stores, two Medicine Shoppe/Medicap stores, five Rite Aid stores, and two Walgreen stores. These reports, including monthly or annual charts by Distributor Defendants and an annual chart by drug strength, are similar to the individual pharmacy reports in Appendix 9.

- **Appendix 10: Other Exhibits**

150. I have been asked by Plaintiff's Counsel to create similar reports in Appendix 9 for pharmacies outside of Cabell County or the City of Huntington, WV. In addition, I created some reports employing a different layout using the numbers in Appendix 9 or the tables/figures of this expert report.

## **IX. Conclusion**

151. Based upon my comparison of the ARCOS Data produced by the DEA, the public ARCOS Retail Drug Summary Reports, and the Defendants' Transactional Data, I conclude that - after correcting a relatively small number of records - the ARCOS Data produced by the DEA is complete and reliable.

152. I further conclude that Cardinal Health's Transactional Data, AmerisourceBergen Drug's Transactional Data, and McKesson Corporation's Transactional Data produced in discovery are reliable sources of transaction data before 2006 and after 2014.

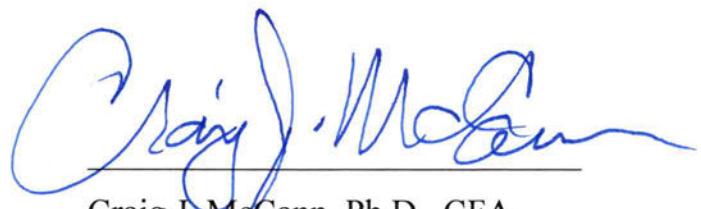
153. The ARCOS Data can be used to identify transactions into a state, county, zip code or individual pharmacy meeting certain criteria as I have illustrated above.

154. I continue to review documents and gather information and reserve the right to update my analysis and opinions based upon that further review of documents and based on any new information including, possibly, reports of other experts I may receive.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and ability.

Executed on

August 3, 2020



Craig J. McCann, Ph.D., CFA

## **Appendix 1 Craig McCann Resume**



**Craig McCann, PhD, CFA  
Principal**

[CRAIGMCCANN@SLCG.COM](mailto:CRAIGMCCANN@SLCG.COM)

703-246-9381

**Key Qualifications**

Dr. McCann is Principal, Securities Litigation and Consulting Group, Inc. He is experienced in securities class action litigation, financial analysis, investment management and valuation. Dr. McCann has taught graduate investment management at Georgetown University and at the University of Maryland, College Park. He held a Series 7 and a Series 63 NASD. Dr. McCann is a Chartered Financial Analyst.



Dr. McCann received a B.A. and an M.A. in Economics from the University of Western Ontario and a Doctorate degree in Economics from the University of California, at Los Angeles. Dr. McCann's fields of graduate study were industrial organization, mathematical economics and information and uncertainty. His dissertation examined the incidence of golden parachutes and their effect on stock prices. After receiving his doctorate degree, Dr. McCann taught economics at the University of South Carolina.

Prior to founding Securities Litigation and Consulting Group, Dr. McCann was Director at LECG and Managing Director, Securities Litigation at KPMG. Dr. McCann was a senior financial economist at the Securities and Exchange Commission. There he focused on investment management issues and contributed financial analysis to numerous investigations involving alleged insider trading, securities fraud, personal trading abuses and broker-dealer misconduct.

Dr. McCann was a Senior Consultant at a consulting firm where he managed projects involving alleged securities fraud, insider trading, and market manipulation. These projects included analysis of materiality, causation, damages and class certification. In addition, he has consulted on transfer pricing, breach of contract, labor and antitrust cases as well as on various regulatory matters.

Dr. McCann has published in the *Alternative Investment Analyst Review*, *Financial Services Review*, *Investments & Wealth Monitor*, *Journal of Alternative Investments*, *Journal of Applied Corporate Finance*, *Journal of Asset Management*, *Journal of Business Valuation and Economic Loss Analysis*, *Journal of Computational Finance*, *Journal of Derivatives*, *Journal of Derivatives & Hedge Funds*, *Journal of Financial Transformation*, *Harvard Business Review*, *Journal of Index Investing*, *Journal of Investing*, *Journal of Legal Economics*, *Journal of Real Estate Portfolio Management*, *Journal of Retirement*, *Journal of Risk* and *Journal of Wealth Management*. He has testified in state and federal court, in NASD, NYSE, JAMS and AAA arbitration proceedings and before the United States Senate and has been quoted in the *New York Times*, *Wall Street Journal*, *Washington Post*, *Bloomberg Markets*, *Reuters*, *Boston Globe*, *Bond Buyer*, *American Banker*, *Money Magazine*, *Kiplinger Retirement Report*, and *Crain's Investment News*.

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### Professional Experience

#### SECURITIES LITIGATION AND CONSULTING GROUP, INC.

2000 - *Principal*  
Provides expert consulting and testifying in securities class actions, investment management, labor and valuation disputes.

#### NAVIGANT CONSULTING, INC. / LECG

1999-2000 *Director*  
Provided expert consulting and testifying in complex litigation.

#### KPMG llp

1997-1999 *Managing Director, Securities Litigation*  
Directed projects in complex litigation.

#### UNIVERSITY OF MARYLAND, COLLEGE PARK

1995-1998 *Adjunct Professor of Finance*  
Taught graduate investment management.

#### GEORGETOWN UNIVERSITY

1996 *Adjunct Professor of Finance*  
Taught graduate investment management.

#### NATIONAL ECONOMIC RESEARCH ASSOCIATES

1995-1997 *Senior Consultant*  
Directed projects in the economics of complex securities litigation.

#### VIRGINIA TECH

1995-1997 *Adjunct Professor of Economics*  
Taught graduate managerial economics.

#### U.S. SECURITIES AND EXCHANGE COMMISSION

1994-1995 *Professional Fellow and Acting Associate Chief Economist for Policy*  
Reviewed Commission initiatives and coordinated research in support of Chief Economist.  
Conducted research into portfolio performance, personal trading and quantitative risk measures.  
Provided financial analysis in support of enforcement.

#### ECONOMIC ANALYSIS CORPORATION

1993-1994 *Senior Economist*  
Directed projects involving analysis of vertical and horizontal practices, mergers, and general business damages.

#### U.S. SECURITIES AND EXCHANGE COMMISSION

1992-1993 *Academic Fellow*  
Conducted research into the valuation and expensing of employee stock options, reviewed policy proposals and supported enforcement actions.

#### UNIVERSITY OF SOUTH CAROLINA, COLLEGE OF BUSINESS

1987-1992 *Assistant Professor*  
Taught economics, antitrust and public policy towards business at undergraduate, masters, MBA and doctorate levels.

Craig J. McCann  
(page 2)

**Education**

UNIVERSITY OF CALIFORNIA, LOS ANGELES

1989 Ph.D., Economics

1986 M.A., Economics

UNIVERSITY OF WESTERN ONTARIO

1983 M.A., Economics

1982 B.A., Economics

Chartered Financial Analyst

Series 7 NASD Registration (1997-1999)

Series 63 NASD Registration (1997-1999)

**Professional Activities**

American Economic Association

American Finance Association

Chartered Financial Analyst Institute

Washington Society of Investment Analysts

**Testimony, Depositions, Reports and Affidavits**

**Federal Court**

*In Re National Prescription Opiate Litigation* United States District Court, Southern District of West Virginia, Civil Action No. 3:17-01362 and 3:17-01665.

Expert Report, August 3, 2020.

*Frieda Mae Rogers v. Wilmington Trust Company et al* United States District Court, District of Delaware, Case No. 18-116-GMS.

Trial Testimony, February 27, 2020.

Deposition, September 20, 2019.

Expert Report, July 26, 2019.

*USA v. James W. Millegan*, US District Court, District of Oregon, Portland Division, Case No. 3:19-cr-00528-IM.

Expert Report, January 16, 2020.

*In Re National Prescription Opiate Litigation* United States District Court, Northern District of Ohio, Eastern Division, Case No. 17-MD-2804 (DAP).

Deposition, May 9-10, 2019.

Second Supplemental Expert Report, April 15, 2019.

Supplemental Expert Report, April 3, 2019

Expert Report, March 25, 2019.

*Securities and Exchange Commission v. RPM International, Inc. et al*, United States District Court, District of Columbia, Case No. 1:16-cv-01803 (ABJ).

Deposition, April 23, 2019.

Rebuttal Expert Report, December 20, 2018.

Expert Report, November 2, 2018.

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(page 3)

*Gary and Caryl Luis et al v. RBC Capital Markets, LLC*, United States District Court, District of Minnesota, Case No. 0:16-cv-3873-SRN-TNL

Deposition, February 21, 2019.

Expert Report, October 20, 2018.

*Peaker Energy Group, LLC et al v Cargill Incorporated et al*, United States District Court Eastern District of Louisiana, Case No. 2:14-CV-02106.

Deposition, October 28, 2016.

Expert Report, August 5, 2016.

*Ernest O. Abbit et al v ING USA Annuity and Life Insurance Company et al*, United States District Court, Southern District of California, Case No: CV 05-6838

Declaration, April 7, 2016.

Deposition, March 13, 2015.

Expert Report, February 20, 2015.

*Patsy Chambers, et al v North American Company for Life*, United States District Court for the Southern District of Iowa Central Division, No. 4:11-CV-00579-JAJ-CFB

Reply Expert Report, April 22, 2015.

Deposition, February 27, 2015.

Supplemental Expert Report, January 30, 2015.

Expert Report, August 18, 2014.

Deposition, July 29, 2014.

Expert Report, March 17, 2014.

*Vida F. Negrete, et al v. Allianz Life Insurance Company*, United States District Court, Central District of California, Case No: CV 05-6838

Declaration, November 1, 2013.

Deposition, May 1, 2012.

Expert Report, March 9, 2012.

Hearing Testimony, October 5, 2011.

Declaration, September 15, 2011.

Deposition, May 27, 2011.

Supplemental Declaration, March 31, 2011.

Deposition, October 29, 2008.

Declaration, July 25, 2008.

Second Supplemental Declaration, September 18, 2006.

Supplemental Declaration, July 16, 2006.

Declaration, May 26, 2006.

*The Municipal Corporation of Bremanger, et al v Citigroup, Inc. et al.* United States District Court, Southern District of New York, Civil Action, Civil Action No. 09-CV-7058.

Declaration, July 13, 2012.

Deposition, April 18, 2012.

Rebuttal Expert Report, March 28, 2012.

Expert Report, February 29, 2012.

*Bank of America, N.A. v JB Hanna et al.* United States District Court, Western District of Arkansas, Civil Action, Civil Action No. 10-5220

Deposition, April 16, 2012.

Expert Report, March 19, 2012.

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(page 4)

*In re: Federal Home Loan Mortgage Corp. (Freddie Mac) Securities Litigation*, United States District Court, Southern District of New York, Civil Action 09-MD-2072 (MGC)

Hearing Testimony, October November December 2011.  
Rebuttal Expert Report, September 14, 2011.  
Deposition, August 2, 2011.  
Expert Report, June 30, 2011.

*Susan Antilla v. L. J. Alfest & Co., Inc.*, United States District Court, District of Connecticut, No. 3:09-CV-2128-VLB

Deposition, December 20, 2011.  
Expert Report, August 12, 2011.

*In re : International Management Associates, LLC*, United States Bankruptcy Court, Northern District of Georgia, Atlanta Division, Case No. 06-62966.

Declaration, December 16, 2011.  
Expert Report, July 7, 2011.

*Thomas Todd Martin, III et al v Wachovia Bank, NA et al*, United States District Court, Northern District of Alabama, Case No.: CV-09-902464

Expert Report, June 17, 2011.

*Corporate America Credit Union v Joseph Herbst, et al*, United States District Court, Northern District of Alabama, Case No.: CV-09-J-2126-S

Rebuttal Expert Report, May 23, 2011.

*Sierra-Sonora Enterprises, Inc. et al v Domino's Pizza, LLC et al*, United States District Court, District of Arizona, NO. 2:10-cv-00105-JAT

Expert Report, August 24, 2010.

*Houston Police Officer's Pension System v. State Street Bank and Trust Company and State Street Global Advisors, Inc.* United States District Court, Southern District of Texas, Houston Division, No. 08-05442-RJH

Declaration, July 1, 2010.  
Deposition, May 10, 2010.  
Rebuttal Expert Report, March 19, 2010.  
Expert Report, January 15, 2010.

*Akanthos Capital Management, LLC, et al v Compucredit Holdings Corporation*, United States District Court, Northern District of Georgia, Atlanta Division, No. 1:10-CV-844-TCB

Declaration, May 7, 2010.

*Securities and Exchange Commission v. Kederio Ainsworth et al*, United States District Court, central District of California, Eastern Division, Civil Action No. EDCV08-1350 VAP(OPx)

Deposition, February 2, 2010.  
Supplemental Expert Report, January 5, 2010.  
Expert Report, December 11, 2009.

*Florence Smith v National Western Life Insurance Company* United States District Court, Middle District of Pennsylvania, Civil Action no. 08-2119

Expert Report, January 4, 2010.

*City of Cedar Rapids and Cedar Rapids/Linn county Solid Waste Agency v. Wells Fargo Brokerage Services, LLC*. United States District Court, Northern District of Iowa, Cedar Rapids Division, No. \_\_\_\_

Rebuttal Expert Report, December 2, 2009.  
Expert Report, September 3, 2009.

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(page 5)

*Daniel G. Schmidt, III v Wachovia Bank, N.A.* United States District Court, Southern District of Texas, Houston Division, No. 08-05442-RJH

Deposition, February 25, 2010.

Expert Report, October 30, 2009.

*In Re Midland National Insurance Co. Annuity Sales Practices Litigation*, United States District Court, Central District of California, No. MDL No. 07-1825 CAS (MANx).

Deposition, September 12, 2009.

Supplemental Declaration, June 19, 2009.

Deposition, January 8, 2008.

Declaration, October 31, 2007.

Deposition, July 27, 2007.

Declaration, July 16, 2007.

Declaration, July 2, 2007.

Declaration, June 29, 2007.

*Securities and Exchange Commission v. Biovail Corporation et al*, United States District Court, Southern District of New York, Civil Action No. 08 CIV 02979 (LAK)

Expert Report, July 2, 2009.

*CountryMark Cooperative, LLP, v Morgan Keegan & Company, Inc.*, United States District Court, Southern District of Indiana, Case No: 1:08-cv-00118-RLY-JMS

Expert Report, April 6, 2009.

*Amy J. Straub et al v UBS Financial services, Inc.*, United States District Court, District of Colorado, Case No: 07-cv-00884-REB-KMT

Deposition, February 22, 2009.

Supplemental Expert Report, January 16, 2009.

Expert Report, January 16, 2009.

*Securities and Exchange Commission v. Competitive Technologies, et al*, United States District Court, District of Connecticut, Civil Action No. 3:04-CV-1331 JCH.

Trial Testimony, October 7, 2008.

Trial Testimony, November 15, 2007.

Deposition, February 22, 2006.

Expert Report, January 30, 2006.

*In Re American Equity Annuity Practices and Sales Litigation*, United States District Court, Central District of California, No. MDL No. CV-05-6735-CAS (MANx).

Deposition, July 24, 2008.

Declaration, April 21, 2008.

*In re Alstom SA Securities Litigation*, United States District Court, Southern District of New York, Case No: 03-CV-6595 (VM).

Affidavit, January 4, 2008.

*Vida F. Negrete, et al v. Fidelity and Guaranty Life Insurance Company*, United States District Court, Central District of California, Case No: CV 05-6837.

Declaration, January 22, 2008.

Declaration, December 26, 2007.

Deposition, August 28, 2007.

Declaration, July 23, 2007.

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*Yuxin (Kevin) Ma et al v Merrill Lynch & Co., Inc. and Irene S. Ng*, United States District Court, Southern District of New York, Case No. 06 CV 15497.

Expert Report, December 24, 2007.

*Dale Sakai v Merrill Lynch Life Insurance Company*, United States District Court, Northern District of California, Case No. CV 06-2581.

Deposition, December 10, 2007.

Expert Report, October 26, 2007.

*Securities and Exchange Commission v. Louis E. Rivelli, et al*, United States District Court, District of Colorado, Civ. 05-CV-1039 RPM-MJW

Deposition, March 3, 2008.

Expert Report, October 8, 2007.

*Kevin Lamkin, et al v. UBS PaineWebber, Inc.*, United States District Court, Southern District of Texas, Civil Action No. H-02-0851

Deposition, February 28, 2007.

Expert Report, June 1, 2006.

*Carmen Migliaccio, et al. v. Midland National Life Insurance Company*, United States District Court, Central District of California, Case No: CV 05-6838.

Deposition, February 13, 2007.

Declaration, December 28, 2006.

*Gary Yockeyama, et al. v. Midland National Life Insurance Company*, United States District Court, District of Hawaii, Case No. 05-00303 MS KSC.

Deposition, November 20, 2006.

Declaration, November 10, 2006.

Declaration, May 4, 2006.

*Samuel Cooper, et al v. Pacific Life Insurance Company et al*, United States District Court, Southern District of Georgia, Case No. CV 203-131

Deposition, September 12, 2006.

Expert Report, July 5, 2006.

*United States of America v. Jamie Olis*, United States District Court, Southern District of Texas, Criminal Number H-03-217.

Expert Report, December 23, 2005.

*David Henderlight and Christine Henderlight v AmSouth Bank*, United States District Court, Eastern District of Tennessee, Knoxville Division Civil Action No: 3:02-CV-169.

Deposition, July 7, 2005.

Expert Report, January 18, 2005.

*United States of America v. Bernard J. Ebbers* United States District Court, Southern District of New York, Docket S4 02 Cr. 1144 (BSJ).

Expert Report June 8, 2005.

*In Re: Kaiser Group International, Inc. et al.*, United States Bankruptcy Court for the District of Delaware, Case Nos. 00-2263 to 00-2301 (MFW).

Declaration, May 29, 2005.

*United States of America v. Shawn P. McGhee* United States District Court, District of Eastern Virginia, Docket 04-495.

Expert Report March 4, 2005.

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(page 7)

*Walnut Capital Partners et al. v Key Bank / McDonald Investments, Inc.*, United States District Court, Western District of Pennsylvania, Case No. 03-CV-0284.

Affidavit, February 14, 2005.  
Deposition, September 8, 2004.  
Supplemental Expert Report July 2, 2004.  
Expert Report June 1, 2004.

*Securities and Exchange Commission v. David Gane et al*/United States District Court, Southern District of Florida Miami Division, Civil Action No:03-61553.

Trial Testimony, December 10, 2004.  
Deposition August 2, 2004.  
Expert Report July 20, 2004.

*Simon Falic et al v Legg Mason Wood Walker, Inc.*, United States District Court, Southern District of Florida, West Palm Beach Division Civil Action No. 03-80377.

Expert Report, October 19, 2004.

*Securities and Exchange Commission v. David W. Butler* United States District Court, Western District of Pennsylvania, Civil Action No. 00-1827.

Trial Testimony September 21, 2004.  
Expert Report January 9, 2003.  
Deposition, October 26, 2001.  
Expert Report October 15, 2001.

*United States of America v. Franklin C. Brown* United States District Court, Middle District of Pennsylvania CR-02-146-02.

Trial Testimony, August 6, 2004.  
Expert Report July 19, 2004.

*United States of America v. Jeffry R. Anderson* United States District Court, District of Eastern Virginia, Docket 1:03-CR-444.

Expert Report January 2, 2004.

*United States of America v. Scott H. Miller* United States District Court, District of Eastern Virginia, Docket No. 03-443-A.

Expert Report December 3, 2003.

*In re: World Access, Inc. Securities Litigation*, United States District Court, Northern District of Georgia Atlanta Division, 1:99-CV-0043-ODE.

Rebuttal Expert Report August 8, 2003.  
Expert Report June 27, 2003.

*In re: Pediatric Services of America, Inc. Securities Litigation*, United States District Court, Northern District of Georgia Atlanta Division.

Expert Report November 19, 2001.  
Affidavit, October 13, 2000.

*United States of America v. Paul F. Polishan* United States District Court, Middle District of Pennsylvania No.3: CR-96-274.

Trial Testimony November 15, 2001.  
Expert Report November 5, 2001.

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(page 8)

*Kantishna Mining Company, Inc. et al v. Gail Norton et al* United States District Court, District of Alaska F98-007 CV.

Declaration, June 1, 2001.

Expert Report and Declaration, April 17, 2001.

*H. James Griggs et al v. Pace American Group, Inc., Coopers & Lybrand L.L.P., et al* United States District Court, District of Arizona.

Trial Testimony, March 13, 2001.

Deposition, December 4, 2000.

Expert Report, November 14, 2000.

*David Lesser, et al v Quadrangle Corporation* United States District Court, District of Eastern Virginia No: 00 Civ. 606-A.

Expert Report, September 8, 2000.

*John Tenaglia and The Tenaglia Family Partnership v. A.F. Best Securities et al*, United States District Court, Southern District of Florida.

Expert Report, March 31, 2000.

*UMG Recordings, Inc. et al v. MP3.com, Inc.*, United States District Court, Southern District of New York, No:00 Civ. 0472.

Expert Report, August 8, 1999.

*Jonathan Bekhor et al v. Josephthal Holdings et al*, United States District Court, Southern District of New York, No: 96 Civ. 4156.

Deposition, September 30, 1999.

Expert Report, August 20, 1999.

*John Shane and Beth Goodman v. Tokai Bank*, United States District Court, Southern District of New York, No:96 Civ. 5187.

Trial Testimony, October 23, 24 1997.

Deposition, October 19, 1997.

Expert Report, October 18, 1997.

#### State Court

*State of Ohio v McKesson et al*. Court of Common Pleas, Madison County, Ohio, Case No. CVH20180055

Deposition, July 15, 2020.

Expert Report, February 22, 2020.

*In Re Opioid Litigation*, 400000/2017 Case Nos. County of Suffolk, 400001/2017, County of Nassau, 400008/2017; and New York State, 400016/2018

Deposition, January 27, 2020.

Expert Report, December 18, 2019.

*In Re Jeffrey Bryan Hall*, State of Ohio, Franklin County, Case No. 04124-17-CR

Expert Report, December 31, 2019.

*Wayne Harwell v Texas Next Capital, L.P., et al* District Court, Bexar County, Texas, 166<sup>th</sup> Judicial District, Case No. 2017CI03737

Deposition, November 26, 2019.

Expert Report, February 21, 2019.

Craig J. McCann  
(page 9)

*State of Washington v. CLA Estate Services, Inc.*, King County Superior Court, Washington, No. 18-2-06309-4 SEA

Deposition, August 7, 2019.

Expert Report, June 14, 2019.

*In Re: Lawrence J. and Florence A. DeGeorge Charitable Trust et al v Lawrence F. DeGeorge et al,* In the Circuit Court of the 15<sup>th</sup> Judicial Circuit in and for Palm Beach County, Probate Division, Case No. 502012CP004397XXXXMB

Trial Testimony, August 21, 2017.

*Douglas Ballinger, et al v Regions Investment Management Inc. et al* In the Sixth Circuit Court of Tennessee for the Twentieth Judicial District at Nashville.

Deposition, April 26, 2017.

Expert Report, March 8, 2017.

*Travis A. Medve v JP Morgan Chase Bank, N.A., et al*, In the District Court of Harris County, Texas, 61st Judicial District, Cause No. 2015-38122

Deposition, February 24, 2017.

Expert Report, December 5, 2016.

*Jack Loperena v Steve Antry, et al*, In the District Court of Tulsa County, State of Oklahoma CJ-2013-03058

Trial Testimony, June 10, 2016.

Deposition, November 4, 2015.

*Roberta Mell v Resnick Investment Advisors, LLC* Superior Court, Judicial District of Stamford/Norwalk State of Connecticut, CV 13-60192015

Deposition, March 11, 2016.

Expert Report, November 3, 2015.

*Frances Brilliard, et al v Morgan Asset Management Inc. et al* In the Circuit Court of Tennessee for the Thirteenth District at Memphis, Shelby County, Case No: DC-09-14448.

Deposition, February 20, 2015.

Expert Report, January 2, 2015.

*Purdue Avenue Investors L.P. et al v Morgan Keegan & Co. Inc, et al*, In the District Court, Dallas County, Texas, 101<sup>st</sup> Judicial District, Case No: DC-09-14448.

Trial Testimony, October 16, 2014.

Deposition, August 22, 2014.

Expert Report, July 15, 2014.

*Francis P. Maybank v BB&T Corporation, et al*, State of South Carolina, County of Greenville, Court of Common Pleas, C.A. No. 2011-CP-23-8578.

Trial Testimony, June 19, 2014.

Deposition, February 7, 2014.

*Robert L. McDonald v Camarind, Mogy & Fife et al*, In The Court of Common Pleas of Allegheny County, Pennsylvania, Case No. CD-11-016862.

Expert Report, July 11, 2013.

*Commonwealth v. Brett B. Weinstein, Esquire, et al* No. 239 M.D. 2006, *Commonwealth v. Estate Planning Advisors Corp, et al* No. 740 M.D. 2004, and *Commonwealth v. Brett B. Weinstein, Esquire, et al* No. 576 M.D. 2001, Commonwealth Court of Pennsylvania.

Expert Report, April 8, 2013.

Craig J. McCann  
(page 10)

*Firefighters Retirement System v Regions Bank et al*, State of Louisiana, Nineteenth Judicial District Court for the Parish of East Baton Rouge, Docket No. 56874, Division 25.

Expert Report, November 1, 2012.

Expert Report, July 20, 2012.

*C. Randall Lewis, Receiver v. Steve Taylor*, District Court, Denver County, Co., Case No. 2011CV2071.

Affidavit, November 1, 2012.

Expert Report, October 8, 2012.

*In Re International Textile Group, Inc. Merger Litigation*, State of South Carolina, County of Greenville, Court of Common Pleas, C.A. No. 2009-CP-23-3346.

Deposition, October 24, 2012.

Supplemental Expert Report, October 19, 2012.

Supplemental Expert Report, July 27, 2012.

Deposition, December 8, 2011.

Expert Report, July 20, 2011.

Deposition, May 13 and May 14, 2011.

Expert Report, April 1, 2011.

*Lennar Corporation et al v Briarwood Capital, LLC et al* Circuit Court, Miami-Dade County, CACE 08-55741 CA 40

Deposition, September 18, 2012.

Expert Report, August 16, 2012.

*Susan W. Gore v Robert Gore et al* Chancery Court, Delaware, C.A. No. 4237-VCN

Rebuttal Expert Report, September 7, 2012.

Expert Report, June 27, 2012.

*Woodbridge Holdings, LLC v Prescott Group Aggressive Small Cap Master Fund et al*, Circuit Court, Broward County, CACE 09-64811.

Trial Testimony, May 31, 2012.

Rebuttal Report, May 23, 2011.

Deposition, May 4, 2012.

Rebuttal Report, April 24, 2011.

Expert Report, April 2, 2011.

*Pursuit Partners, LLC and Pursuit Management, LLC v. UBS AG Securities LLC et al*, Superior Court, Judicial District of Stamford-Norwalk at Stamford No. X05-CV-08-4013452-S

Deposition, June 7, 2011.

Expert Report, May 5, 2011.

*Petition of Bank One Trust Company, N.A. For Instruction and Construction of Trust*, District Court, Tulsa County, State of Oklahoma, Case No. PT-2006-013

Trial Testimony, April 19 and May 19, 2011.

Supplemental Expert Report, November 16, 2009.

Deposition, December 15, 2008.

Expert Report, June 13, 2008.

*BBC-T Asset Management, Inc., et al v Frederick V. Martin*, Virginia Circuit Court for the City of Norfolk Case No. CL07006153-00

Expert Report, August 15, 2008.

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*Ross Gampel et al v Northern Trust Bank of Florida*, Circuit Court, Broward County, CACE 05-18352 CA 31,  
Deposition, April 17, 2008.

*Cynthia Weiss v Robert Sturman, et al* In The Court of Common Pleas of Philadelphia County,  
August Term, 2006 NO. 3332  
Expert Report January 23, 2008.

*Salix Affiliates et al v Lattimore, Black, Morgan & Cain, P.C.*, Chancery Court, Tennessee Case No. 06-1500-IV  
Deposition, December 5, 2007.  
Expert Report, September 21, 2007.

*Tafazzoli Family Limited, et al v. TradeStation Group, Inc. et al* Circuit Court, Miami-Dade County, CACE 03-19815 CA 40.  
Deposition, September 18, 2007.

*Glenn Wall, et al v. James F. Bottoms, et al* State Court of Fulton County, Georgia, Case No. 06VS091950F.  
Deposition, June 19, 2007.

*Andrew A. Allen Family Limited Partnership v. TradeStation et al* Circuit Court, Broward County, CACE 03-014229.  
Trial Testimony, May 4, 2007.  
Deposition, February 20, 2007.

*Remmora Investments v Robert Orr*, Circuit Court of Fairfax County, VA No. 187948  
Trial Testimony, November 20, 2006.  
Deposition, October 9, 2006.

*Gerardo Martin Demeritis Chau, et al, v. Mohammed Abu-Ghazaleh, et al* Circuit Court, Miami-Dade County, CACE 02-31670 CA 32.  
Trial Testimony, November 6, 2006.  
Deposition, October 11, 2005.  
Expert Report July 15, 2005.

*Calomiris v Calomiris*, District of Columbia Superior Court, Civil Action No. 05-0004062  
Deposition, October 11, 2006.

*Jack Holtzberg and Elaine M. Holtzberg v. Citigroup et al* Circuit Court, Palm Beach County, CACE 50 2004CA000837  
Affidavit, August 28, 2006.

*Majestic Enterprises v. Northern Trust Bank of Florida* Circuit Court, Broward County, CACE 03-19243.  
Deposition, July 26, 2006.

*San Carlos Apache Tribe Government Employee's 401(K) v. A. Thomas Ullmann et al*, Superior Court of Arizona, Case No. CV2005-005942.  
Supplemental Expert Report, July 24, 2006.  
Expert Report, June 30, 2006.

*Patrick T. Noonan and Nancy J. Noonan v. Hackett Investment Advisors, Inc. et al*, Superior Court of Arizona, No. CV2005-010186.  
Deposition, June 21, 2006.

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(page 12)

*Stephen F. Johnston et al v Baran Group et al*, Superior Court of Fulton County, State of Georgia,  
Case No. 2004CV89313.

Deposition, June 28, 2006.  
Expert Report June 9, 2006.

*Carol Pomerantz et al v. Northern Trust Bank of Florida, et al* Circuit Court, Broward County,  
CACE 02-015246-08,  
Deposition, October 5 and October 12, 2005.

*Carney Family Irrevocable Trust of 1999 v State Street Global Advisors, et al* Superior Court of  
Commonwealth of Massachusetts, CIV. 03-2716 BLS 2  
Deposition, June 21, 2005.

*Trust Estate of Emanuel Rosenfeld, Settlor In The Court of Common Pleas of Philadelphia  
County, Orphans' Court Division, O.C. NO. 1664 IV OF 2002*  
Trial Testimony, May 3, 2005.  
Expert Report April 8, 2005.

*Evi U. Chammess et al v. Northern Trust Bank of Florida, et al* Circuit Court, Broward County,  
CACE 03-001939-12,  
Deposition, February 17 and February 18, 2005.  
Affidavit, November 19, 2004.

*Ponswamy Rajalingham et al v Urecoats International, Inc. et al*, Circuit Court, Broward County,  
CACE 02-009324,  
Deposition, March 1, 2004.

*William J. Kerley v. McCullough, Sherrill LLP, et al* State Court of Fulton County, State of  
Georgia, Civil Action No. 02VS028870E,  
Affidavit, March 12, 2004.  
Deposition, September 11, 2003.

*Plantation Sales, Inc. dba Plantation Nissan/Volvo v Northern Trust Bank of Florida*, Circuit Court,  
Broward County, CACE 02-006761 (05),  
Deposition, February 19, 2004.

*Century Business Services v Victor C. Moore*, Court of Common Pleas, Cuyahoga County, Case  
No. 469291,  
Trial Testimony, February 9, 2004.  
Deposition, January 19, 2004.

*Michael B. Holt, as Trustee of the Mark E. Munro Charitable Remainder Unitrust, v. Merrill Lynch  
Trust Co., et al* Superior Court of New Jersey, Docket # ESX-L-6713-02  
Deposition, January 15, 2004.  
Expert Report, September 8, 2003.

*Jack E. Forbes v. A.G. Edwards, et al* Circuit Court of Monongalia County, State of West  
Virginia, Civil Action No. 01-C-325  
Trial Testimony, December 11, 2003.  
Deposition, September 30, 2003.

*In re: Thompsons vs. Glenmede Trust Company*, Court of Common Pleas Philadelphia County,  
Pennsylvania February Term 2002, 004428  
Expert Report, August 25, 2003.

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(page 13)

*In re: Moutsatsos vs. Glenmede Trust Company*, Court of Common Pleas Philadelphia County, Pennsylvania May Term 2001, 003659  
Expert Report, July 7, 2003.

*Nancy J. Needham et al v. Advanced Communications et al* Circuit Court of Florida, Fifteenth Judicial Circuit, Case No.: 00-0067-CA-HDH  
Affidavit, May 15, 2003.

*JDN Realy et al v. McCullough, Sherrill LLP, et al* Superior Court of the State of Georgia, Civil Action No. 01-CV-39193,  
Deposition, April 8, 2003.

*Desendorf v Riggs Bank*, District of Columbia Superior Court, Civil Action No. 00502-01  
Deposition, April 24, 2002.

*Ratcliff Family Charitable Remainder Trust et al v. Apperlee Capital Management et al* Circuit Court of Collier County, Florida Case No.: 00-0067-CA-HDH  
Affidavit, August 22, 2001.

*Mabwash Sabet v. Olde Discount Corporation et al*, Superior Court of Arizona  
Affidavit, July 31, 2001.  
Trial Testimony, April 24 and April 25, 2001.  
Deposition, January 22 and January 23, 2001.  
Supplemental Expert Report, October 11, 2000.  
Expert Report, August 31, 2000.  
Affidavit, February 17, 2000.

*Pierce v van Beuren*, Circuit Court of Rappahannock County, VA  
Trial Testimony, January 24, 2001.

*Jason A. Forge et al v. National Semiconductor Corp. et al*, Superior Court of the State of California, County of Santa Clara CV 770082  
Deposition, May 18, 2000.

#### International

*Great Canadian Gaming Corp., et al v. British Columbia Lottery Commission* Supreme Court of British Columbia, Vancouver Registry No.: S-152587.  
Expert Report, March 23, 2019.

*In the Matter of Home Capital Group Inc et al*, before the Ontario Securities Commission  
Expert Report, May 26, 2017.

*In the Matter of Jowdat Wabeed and Bruce Walter*, before the Ontario Securities Commission  
Expert Report, December 24, 2012.

*In the Matter of Biovail Corporation et al*, before the Ontario Securities Commission  
Trial Testimony, April 9, 2009.  
Expert Report, February 27, 2009.

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(page 14)

**AAA, JAMS and Other Arbitrations**

*Denise Pierson Newman et al v Millennium Trust Company*, JAMS Arbitration  
Expert Report, September 3, 2019.

*Joseph M. Piccirilli et al v U.S Trust*, JAMS Arbitration  
Rebuttal Expert Report, April 17, 2019  
Expert Report, March 15, 2019.

*Kasti Shirvaninan v Citigroup Global Markets Inc. (f/k/a) Salomon Smith Barney* AAA  
Arbitration

Trial Testimony, December 16, 2016.  
Trial Testimony, February 8, 2016.  
Deposition, January 15, 2016.

*Estate of Carroll S. Wahrsen v Genspring*, JAMS Arbitration  
Expert Report, May 3, 2016.

*Poston Lumber, LLC et al v TBSG, LLC et al* JAMS Arbitration  
Trial Testimony, April 13, 2016.

*Albert C. Woodroof et al v Genspring*, JAMS Arbitration  
Expert Report, March 13, 2015.

*Michael Gould and Janice Gould v Genspring*, JAMS Arbitration  
Expert Report, January 12, 2015.

*Metzler et al v Calboun et al*, Henning Mediation & Arbitration  
Trial Testimony, October 16, 2014.

*Oscar Williams et al v Montecito*, AAA Arbitration  
Trial Testimony, August 26, 2014.

*Auto City Service, Inc., et al v JP Morgan Chase Bank*, AAA Arbitration  
Expert Report, July 9, 2014.

*Allina Health System v UBS Securities, LLC*, AAA Arbitration  
Declaration, March 5, 2014.

*Randal Golden v Genspring*, AAA Arbitration  
Expert Report, November 1, 2013.

*Richard Golden v Genspring*, AAA Arbitration  
Trial Testimony, June 6, 2012.  
Rebuttal Expert Report, May 21, 2012.  
Expert Report, April 6, 2012.

*St. Anthony Foundation vs. SCM Advisors, LLC* AAA Arbitration  
Trial Testimony, March 8, 2011.

*Stephen Tigerman v Heller Capital Resources, Inc. et al* JAMS Arbitration  
Trial Testimony, February 9, 2011.  
Deposition, January 6, 2011.

*Peter Fusco v Fisher Investments, Inc.* AAA Arbitration,  
Trial Testimony, September 16, 2010.

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(page 15)

*Elliott C. Levinthal et al v. First Republic Securities Company LLC et al AAA Arbitration*  
Trial Testimony, April 7, 2010.

*Matthew Schoenberg et al v Wells Fargo Bank, N.A. et al AAA Arbitration*  
Trial Testimony, January 11, 2010.  
Deposition, January 5, 2010.  
Expert Report, December 11, 2009.

*Robert Tandler et al v. First Republic Securities Company LLC et al AAA Arbitration*  
Trial Testimony, August 25, 2009.

*CRG Partners, Inc. et al v Genesis Technology Group, AAA Arbitration*  
Trial Testimony, December 4 and December 23, 2008.  
Deposition, November 26, 2008 and December 19, 2008.  
Supplemental Expert Report, December 18, 2008.  
Expert Report, November 24, 2008.

*Anthony Ostlund & Baer, P.A. et al v Vigilant Investors L.P. et al AAA Arbitration*  
Trial Testimony, October 30, 2008.

*Dominion Terminal Associates v. CSX Transportation, Inc., AAA Arbitration*  
Deposition, June 23, 2006.  
Expert Report, May 17, 2006.  
Declaration, February 9, 2006.

*Bradley Markham and John Truchanowicz v Black Box Inc., AAA Arbitration*  
Trial Testimony, June 4, 2002.  
Expert Report, May 22, 2002.

*Douglas Millar et al v Merrill Lynch, et al JAMS Arbitration*  
Trial Testimony, May 9, 2002.  
Supplemental Expert Report, April 10, 2002.  
Expert Report, March 23, 2002.

*Raymond H. Stanton II and Raymond H. Stanton III v. Cendant Corporation, AAA Arbitration,*  
Trial Testimony, October 16 and 18, 2000.  
Expert Report, February 9, 2000.

#### NASD, NYSE and FINRA Arbitrations

Dr. McCann has testified before approximately 400 NASD, NYSE, and FINRA arbitrations.

#### Miscellaneous Testimony

*New Hampshire, Secretary of State, Bureau of Securities Regulation v Steven Meyer. State of New Hampshire, Secretary of State, Bureau of Securities Regulation*  
Affidavit, June 29, 2017.

*In the Matter of Zachary Mannes and Raphi Capital Management LLC Before the Securities Commissioner of Maryland, Case No. 2015-0128*  
Expert Report, November 1, 2016.

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(page 16)

*In the Matter of Timothy K. Fife* Before the Ohio Department of Commerce, Division of  
Securities, Case No. 14-028

Hearing Testimony, September 9, 2015.

*In the Matter of St. Bernard Financial Services, Inc., Robert Keenan and Steele Steppens*, Before the  
Arkansas Securities Commissioner, Case No. S-12-0063

Hearing Testimony, April 6, 2015.

Deposition, September 8, 2014.

Expert Report, December 20, 2013.

*In the Matter of Focus Capital and Nicolas Rowe*. Respondent. State of New Hampshire, Secretary  
of State, Bureau of Securities Regulation

Expert Report, December 7, 2012.

*In the Matter of UBS Financial Services, Inc.* Respondent. State of New Hampshire, Secretary of  
State, Bureau of Securities Regulation

Expert Report, February 17, 2011.

*South Beach Securities Inc.* before the National Securities Clearing Corporation,

Hearing Testimony February 9, 2000.

Expert Report January 31, 2000.

*Report on The Adequacy of the SIPC Fund* to the Board of Directors of Securities Investor  
Protection Corporation, April 22, 1998.

Before the Subcommittee on Securities of the Senate Banking Housing and Urban Affairs  
Committee, “How (and Why) Companies Should Value Their Employee Stock Options”  
Senate Hearings No. 103-359, October 21, 1993.

#### Publications and Working Papers (available at [www.slcg.com](http://www.slcg.com))

“UBS Yield Enhancement Strategy Returns - and then the Losses – Were Caused by Equity Market  
Exposure” with Regina Meng and Edward O’Neal, 2019, working paper.

“Rating Brokerage Firms by Their Complaint Histories Rather Than by Their Brokers’ Histories,”  
with Chuan Qin and Mike Yan, 2017, working paper.

“Efficient Valuation of Equity-Indexed Annuities Under Levy Processes Using Fourier-Cosine  
Series” with Geng Deng, Tim Dulaney and Mike Yan, 2017, *Journal of Computational Finance*,  
Vol 21, No 2, pp 1-27.

“How Widespread and Predictable is Stock Broker Misconduct?” with Mike Yan and Chuan Qin,  
*Journal of Investing*, Summer 2017, pp. 6-25.

“Structured Products and the Mischief of Self-Indexing” with Mike Yan and Geng Deng, *Journal of  
Index Investing*, Spring 2017, pp. 16-29.

“An Empirical Analysis of Non-traded REITs”, with Brian Henderson and Joshua Mallett, *Journal of  
Wealth Management*, 19(1): 83-94, Summer 2016.

“Fiduciary Duties and Non-Traded REITs” *Investments & Wealth Monitor* July/August 2015.

“Ex-post Structured Product Returns: Index Methodology and Analysis” with Geng Deng, Tim  
Dulaney, Tim Husson and Mike Yan, *Journal of Investing*, Summer 2015, Vol. 24, No. 2: pp.  
45–58.

“Structured Certificates of Deposit: Introduction and Valuation”, with Geng Deng, Tim Dulaney  
and Tim Husson, *Financial Services Review* Volume 23, Number 3, 2014.

Craig J. McCann  
(page 17)

"Large Sample Valuations of Tenancies-in-Common" with Timothy Husson, Edward O'Neil and Carmen Taveras, *Journal of Real Estate Portfolio Management*, vol. 20, no. 2 2014.

"A Primer on Non-Traded REIT's and Other Alternative Real Estate Investments" with Tim Husson and Carmen Taveras, *Alternative Investment Analyst Review*, 2014.

"Dual Directional Structured Products" with Geng Deng, Tim Dulaney and Tim Husson, 2014. *Journal of Derivatives and Hedge Funds* Volume 20, Issue 2 (May 2014).

"Private Placement Real Estate Valuation" with Timothy Husson, Edward O'Neil and Carmen Taveras, 2014, *Journal of Business Valuation and Economic Loss Analysis* Volume 9, Issue 1 (Jan 2014).

"Valuation of Structured Products" with Geng Deng and Tim Husson, 2014, *Journal of Alternative Investments* Spring 2014, Vol. 16, No. 4: pp. 71–87

"Modeling a Risk-Based Criterion for a Portfolio with Options" with Geng Deng and Tim Dulaney, *Journal of Risk*, Vol. 16, No. 6.

"The Fall of Willow" with Geng Deng, 2014.

"Structured Product Based Variable Annuities" with Geng Deng, Tim Dulaney and Tim Husson, *Journal of Retirement* Winter 2014, Vol. 1, No. 3: pp. 97-111.

"Valuation of Reverse Convertibles in the Variance Gamma Economy" with Geng Deng and Tim Dulaney, *Journal of Derivatives and Hedge Funds*. (2013) 19, 244–258.

"Crooked Volatility Smiles: Evidence from Leveraged and Inverse ETF Options" with Geng Deng, Tim Dulaney and Mike Yan, *Journal of Derivatives and Hedge Funds*, (2013) 19, 278–294.

"Robust Portfolio Optimization with Value-at-Risk Adjusted Sharpe Ratios," with Geng Deng, Tim Dulaney and Olivia Wang *Journal of Asset Management*, (2013) 14, 293–305.

"Using EMMA to Assess Municipal Bond Markups" with Geng Deng, 2013.

"Municipal Bond Markups" with Geng Deng, 2013.

"Optimizing Portfolio Liquidation Under Risk-Based Margin Requirements" with Geng Deng and Tim Dulaney, *Journal of Finance and Investment Analysis*, vol. 2, no. 1, 2013, 121-153.

"The Priority Senior Secured Income Fund," with Tim Dulaney and Tim Husson, 2013.

"What is a TIC Worth?" with Tim Husson and Carmen Taveras, 2013.

"The Rise and Fall of Apple-linked Structured Products" with Geng Deng, Tim Dulaney and Mike Yan, 2013.

"Are VIX Futures ETPs Effective Hedges?" with Geng Deng and Olivia Wang, 2012, *Journal of Index Investing*, 3(3):35-48, Winter 2012.

"The Properties of Short Term Investing in Leveraged ETFs" with Geng Deng, *Journal of Financial Transformation*, October 2012.

"Leveraged Municipal Bond Arbitrage: What Went Wrong?" with Geng Deng, 2012, *Journal of Alternative Investments*, Spring 2012, Vol. 14, No. 4: pp. 69–78.

"Isolating the Effect of Day-Count Conventions on the Market Value of Interest Rate Swaps" with Geng Deng, Tim Dulaney and Tim Husson, 2012.

"CLOs, Warehousing, and Banc of America's Undisclosed Losses" with Tim Husson and Olivia Wang, 2012.

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(page 18)

"Using Monte-Carlo Simulation Techniques to Value Partial Interests in Trusts and Assess the Prudent Investor Standard" with Geng Deng and Tim Husson, 2012.

"Rethinking the Comparable Companies Valuation Method" with Paul Godek, Dan Simundza and Carmen Tavecas, 2011.

"The Anatomy of Principal Protected Absolute Return Barrier Notes" with Geng Deng, Ilan Guedj and Joshua Mallett, 2011, *Journal of Derivatives*, Winter 2011, Vol. 19, No. 2: pp. 61-70.

"Modeling Autocallable Structured Products" with Geng Deng and Joshua Mallett, 2011, *Journal of Derivatives & Hedge Funds* 17, 326-340.

"What Does a Mutual Fund's Term Tell Investors?" with Geng Deng and Edward O'Neal, *Journal of Investing* Summer 2011 vol. 20.

"The VXX ETN and Volatility Exposure" with Tim Husson, 2011.

"Futures-Based Commodities ETFs" with Ilan Guedj and Guohua Li, *Journal of Index Investing*, Summer 2011 vol. 2, no. 1.

"What Does a Mutual Fund's Average Credit Quality Tell Investors?" with Geng Deng and Edward O'Neal, *Journal of Investing* Winter 2010 vol. 19, no. 4.

"Leveraged ETFs, Holding Periods and Investment Shortfalls" with Ilan Guedj and Guohua Li, 2010, *Journal of Index Investing* Winter 2010 vol. 1, no. 3.

"Charles Schwab YieldPlus" with Geng Deng, and Edward O'Neal, 2010.

"What TiVo and JP Morgan teach us about Reverse Convertibles", with Geng Deng, Edward O'Neal, and Guohua Li, 2010.

"The Risks of Preferred Stock Portfolios," with Guohua Li and Edward O'Neal, 2010.

"Auction Rate Securities" with Edward O'Neal, 2010.

"Structured Products in the Aftermath of Lehman Brothers" with Geng Deng and Guohua Li, 2009.

"Oppenheimer Champion Income Fund" with Geng Deng and Joshua Mallett, 2009.

"Regions Morgan Keegan and the Abuse of Structured Finance", 2009.

"An Economic Analysis of Equity-Indexed Annuities", 2008.

"A CMO Primer: The Law of Conservation of Structured Securities Risk", 2007.

"Are Structured Products Suitable for Retail Investors?" with Dengpan Luo, 2006.

"An Overview of Equity-Indexed Annuities" with Dengpan Luo, 2006.

"Annuities" with Kaye A. Thomas, 2005.

"Optimal Exercise of Employee Stock Options and Securities Arbitrations" with Kaye A. Thomas, 2005.

"Concentrated Investments, Uncompensated Risk and Hedging Strategies" with Dengpan Luo, 2004.

"The Use of Leveraged Investments to Diversify a Concentrated Position" with Dengpan Luo, *Securities Arbitration 2004 Handbook* PLI.

"Detecting Personal Trading Abuses", 2003.

"Churning Revisited: Trading Costs and Control" with Dengpan Luo, *Securities Arbitration 2003 Handbook* PLI.

"The Suitability of Exercise and Hold," with Dengpan Luo, *Securities Arbitration 2002 Handbook*, PLI.

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(page 19)

"Spreads, Markdowns, Sales Credits and Trading Costs," with Richard Himeskirk, Esq.

"The Prudent Investor Rule, Uniform Prudent Investor Act and Financial Theory," 2000.

"Economic Analysis in Broker Customer Disputes Involving Allegations of Churning," *Journal of Legal Economics* 9:1 Spring/Summer 1999.

"A Comment on Accelerated Trading Models Used in Securities Class Action Lawsuits," with David Hsu, *Journal of Legal Economics* 8:3 Winter 1998-1999.

"How (and Why) Companies Should Value Their Employee Stock Options," *Journal of Applied Corporate Finance* Summer 1994, Volume 7 number 2, page 91.

"Perspectives: Taking Account of Stock Options," *Harvard Business Review* January-February 1994, Volume 72 number 1, page 27.

"Golden Parachutes: A Theoretical and Empirical Investigation," unpublished Ph.D. dissertation, UCLA, 1989.

**Presentations at Conferences and Colloquia**

Dr. McCann has been invited to speak on prudent investment management practices, financial analysis in securities arbitrations, securities class action lawsuits and antitrust litigation on more than 65 continuing legal education and conference panels around the country.

August 3, 2020

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## **Appendix 2 Corrections to the ARCOS Data**

155. I exclude certain transactions in the ARCOS Data and make corrections to other transactions in the ARCOS Data.

156. I make eight types of changes:

- a. I exclude duplicate transactions, when the same transaction was reported to ARCOS more than once by the same registrant.
- b. I exclude transactions where the Drug Code from the NDC dictionary is not one of the 14 opioids listed in Table 1.
- c. I exclude transactions where the Action Indicator code, Correction Number, or both suggest the reported transaction is erroneous.
- d. I exclude all transactions involving reverse distributors, analytical labs, importers, exporters, or researchers, because they are not relevant to my analysis. In addition, reverse distributors overstate the quantity of opioids shipped for destruction.
- e. I exclude transactions between two registrants, when the transaction is reported by the registrant receiving the shipment, because the transaction was already reported to ARCOS by the registrant sending the shipment.
- f. I exclude transactions with obvious errors in the reported Quantity.
- g. I exclude transactions with Transaction Code “X” (Lost-in-Transit), because “Transaction Code X is an explanatory

transaction code which does not affect an ARCOS registrant's inventory.”<sup>42</sup>

- h. I correct the Calculated Base Weight In Grams when it was calculated using an incorrect Ingredient Base Weight from the NDC dictionary.

#### **A. Duplicate Transactions**

157. The ARCOS Data had 610,381 duplicate transactions in December 2007 for one of the Cardinal Health distribution centers (Seller DEA Number: RC0221236). I kept one of each group of exact duplicate transactions so that there was only one record of each transaction.

#### **B. NDC Dictionary**

158. Three of the fields in the ARCOS Data (NDC, Drug Code, and Drug Name) can also be found in the NDC Dictionary.<sup>43</sup> I checked the accuracy of the Drug Code and Drug Name in the ARCOS Data by comparing those fields to the information in the NDC Dictionary.<sup>44</sup> When the two sources listed different Drug Codes or Drug Names, I updated the ARCOS Data to

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<sup>42</sup> ARCOS Handbook, §5.8.3, p. 5-19.

<sup>43</sup> The DEA’s NDC dictionary is available at [www.deadiversion.usdoj.gov/arcos/ndc/ndcfile.txt](http://www.deadiversion.usdoj.gov/arcos/ndc/ndcfile.txt). The dictionary is explained at [www.deadiversion.usdoj.gov/arcos/ndc/readme.txt](http://www.deadiversion.usdoj.gov/arcos/ndc/readme.txt). The DEA updates the NDC dictionary monthly to correct errors, add new drug products, and remove discontinued drug products. I used the NDC dictionary updated on November 1, 2018, plus any discontinued drug products from earlier versions of the NDC dictionary in May 2018 – October 2018. An alternative NDC dictionary is maintained by the FDA ([www.accessdata.fda.gov/scripts/cder/ndc/index.cfm](http://www.accessdata.fda.gov/scripts/cder/ndc/index.cfm)).

<sup>44</sup> I matched the ARCOS Data to the NDC Dictionary using NDC. For the Drug Code, I compared the first four digits of the Drug Code in the ARCOS Data to the first four digits of the Drug Code in the DEA’s NDC dictionary. 156 NDCs in the ARCOS Data were not in the DEA’s NDC dictionary.

reflect the information in the November 2018 NDC Dictionary because the NDC Dictionary is updated monthly and I observe the DEA correcting errors in the NDC Dictionary. As a result of the comparison, I updated the Drug Code and Drug Name in 1,729 reported transactions (less than 0.0001% of the transactions).

159. After confirming the accuracy of the Drug Codes and Drug Names in the ARCOS Data, I found and removed 1,664 transactions (less than 0.0001% of the transactions) reported in the ARCOS Data which did not include any of the fourteen opioids in Table 1.

160. I also checked the accuracy of Calculated Base Weight in Grams in the ARCOS Data and found some NDCs for which the ARCOS Data incorrectly reported the Calculated Based Weight in Grams because it relied on an incorrect Ingredient Base Weight in the NDC Dictionary.<sup>45</sup> I reviewed the Ingredient Base Weights in the NDC Dictionary for all NDCs with Dosage Units in the ARCOS Data and flagged Ingredient Base Weights as potentially incorrect if the weight of the drug per dosage form (*e.g.*, capsule, tablet, patch) was significantly different than other drug products with the same base drug and dosage strength.

161. For example, the NDC Dictionary reported that NDC 00056012770 (Percocet 5 mg tablets) contains 0.4483 milligrams of oxycodone per 100 tablets (0.004483 milligrams per tablet). Given other data in the NDC Dictionary, it is apparent that each 5-milligram tablet has 4.483

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<sup>45</sup> Calculated Base Weight in Grams is a function of the Quantity, Unit, and Strength fields in the ARCOS Data, and the Ingredient Base Weight in the NDC Dictionary.

milligrams of oxycodone.<sup>46</sup> I concluded that this NDC’s Ingredient Base Weight in the NDC Dictionary and Calculated Base Weight in Grams in the ARCOS Data should be 1,000 times larger, and accordingly increased the Calculated Base Weight in Grams for this NDC.

162. I corrected the Calculated Base Weight in Grams of 14 NDCs in 285,891 reported transactions (approximately 0.06% of the reported transactions).<sup>47</sup> The DEA’s NDC Dictionary also includes the trade name of the drug product (“Trade/Product Name”) and the dosage form (“Package Measure”), which I added to the ARCOS Data.

163. Finally, I checked the accuracy of the Dosage Unit in the ARCOS Data by using the NDC Dictionary. I multiplied the Quantity in the ARCOS Data by the Package Quantity in the NDC Dictionary. I did not find any discrepancies.

### C. Erroneous Transactions

164. I found and corrected four categories of erroneous transactions in the ARCOS Data.

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<sup>46</sup> The drug’s Ingredient Base Weight (*e.g.*, 448.3 mg per 100 tablets) does not match the dosage strength (*e.g.*, 500 mg per 100 tablets) because the Ingredient Base Weight is presented in terms of the anhydrous base form of the drug, while the dosage strength is presented in terms of the salt form of the drug. *See* p. 6-3 and Appendix 3 of the ARCOS Handbook.

<sup>47</sup> Subsequent versions of the DEA’s NDC dictionary appear to have been updated to correct the errors I found. Thus, each version of the DEA’s NDC dictionary should be evaluated separately for necessary drug weight corrections.

*1. Transactions where ACTION\_INDICATOR and CORRECTION\_NO are both populated.*

165. The ARCOS Handbook explains that both the Action Indicator and Correction Number fields should never be populated for the same transaction. I found and deleted 59,223 such erroneous transactions (approximately 0.01% of the transactions).<sup>48</sup>

*2. Adjustments to previously reported transactions.*

166. Reporters can adjust a previously reported transaction by submitting an adjusted transaction to ARCOS with ACTION\_INDICATOR = “A” and submitting a deletion request for the originally reported transaction.<sup>49</sup> I identified 483,885 instances where the ARCOS Data included an adjusted transaction and either the originally reported transaction, the deletion request, or both.<sup>50</sup> I deleted the deletion request and the originally reported transaction.

*3. Deletions of previously reported transactions.*

167. Reporters can delete a previously reported transaction from ARCOS by re-submitting the transaction with ACTION\_INDICATOR = “D”.<sup>51</sup> I identified 2,492 instances where the ARCOS Data included the

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<sup>48</sup> See ARCOS Handbook, §7.4, p. 7-5.

<sup>49</sup> See ARCOS Handbook, §5.9.2, p. 5-20; §7.5.1, p. 7-13; and §7.8.2, p. 7-19.

<sup>50</sup> I identified the original record by matching the Reporter DEA Number, the Buyer DEA Number, the transaction month and year, the Drug Code, and the Transaction ID.

<sup>51</sup> See ARCOS Handbook, §5.9, pp. 5-19 through 5-20, and §7.5.1, p. 7-12.

deletion request and the original reported transaction.<sup>52</sup> I deleted the original transaction and the deletion request.

4. *Corrections of previously reported transactions.*

168. Reported transactions are sometimes rejected by ARCOS. The Reporter can then re-submit the transaction as a correction transaction. Correction transactions are identified by a record identifier in the CORRECTION\_NO field.<sup>53</sup> I identified 17,320 instances where the ARCOS Data included both the rejected transaction and the corrected transaction. I kept the corrected transaction and deleted the originally reported transaction.<sup>54</sup>

**D. Transactions Involving Reverse Distributors, Analytical Labs, Importers, Exporters or Researchers**

169. Reverse distributors, manufacturers and distributors ship opioids to analytical labs for destruction. Usually, manufacturers and distributors ship the opioids to the reverse distributors, who then ship them to the analytical labs. However, manufacturers and distributors sometimes ship opioids directly to analytical labs. Opioids shipped to reverse distributors or analytical labs are virtually never subsequently shipped to Dispensers.<sup>55</sup> I exclude transactions in the ARCOS Data involving reverse distributors or analytical labs because my analysis is focused on the flow of opioids to Dispensers.

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<sup>52</sup> I identified the original record by matching the Reporter DEA Number, the Buyer DEA Number, the Transaction ID, the Transaction Date, the Order Form Number, the NDC, and the Quantity.

<sup>53</sup> See ARCOS Handbook, §5.16, p.5-42 and §7.5, pp. 7-12 through 7-15.

<sup>54</sup> I identified the original record by matching the Reporter DEA Number, the Buyer DEA Number, the transaction month and year, the Drug Code, and the Transaction ID.

<sup>55</sup> The ARCOS Data reports 23,275 grams (Calculated Base Weight) of opioids were shipped from reverse distributors to Dispensers.

170. In addition, a number of transactions reported by reverse distributors have astronomical Calculated Base Weight in Grams either because the Unit code, used to specify the Quantity's unit of measurement, is set for kilograms when the most likely unit is milligrams for most opioids or micrograms for fentanyl, or because the Quantity itself is astronomical. For example, one pair of transactions reported by a reverse distributor in Georgia includes a receipt (coded P) of 45,902 metric tons of morphine from a manufacturer and a matched shipment for destruction (coded Y) to an analytical lab in Florida. In total, the ARCOS Data reflects 539,839 metric tons of opioids being shipped to analytical labs for destruction.

171. The ARCOS Data reports a relatively small quantity of opioids (91.3 metric tons of Calculated Base Weight) being sent to importers, exporters or researchers. I exclude transactions in the ARCOS Data involving importers, exporters or researchers because my analysis is focused on the flow of opioids to Dispensers.

#### **E. Transactions between ARCOS Registrants**

172. Transactions between ARCOS registrants should be reported twice in the ARCOS Data, once by each registrant. For example, a shipment from a manufacturer to a distributor should be reported once by the manufacturer and once by the distributor. To avoid double-counting, I keep the transaction reported by the registrant sending the shipment, and exclude the transaction reported by the registrant receiving the shipment.

#### **F. Transactions with Obvious Errors in Quantity**

173. I also exclude transactions with obvious errors in Quantity. For example, I exclude a single sale transaction of Hydrocodone/APAP tablets

from a distributor to a practitioner in the Northern Mariana Islands that has a Calculated Base Weight of 34 metric tons.

#### **G. Transaction Code “X”**

174. I exclude all transactions with Transaction Code “X”. The ARCOS Handbook explains that this code “is used by the seller to report the loss or theft of an in-transit shipment of a reportable controlled substance. It is reported **in addition** to the normal sales transaction (transaction code S). Transaction code X is an **explanatory** transaction code that does not affect an ARCOS registrant’s inventory.”<sup>56</sup>

175. Table 41 summarizes the effect of my exclusions and corrections on the number of transactions and the total Calculated Base Weight in Grams in the ARCOS Data.

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<sup>56</sup> ARCOS Handbook, §5.8.3, p. 5-19 (emphasis in original).

Table 41 Exclusions and Corrections to the ARCOS Data

	<b>Change in # of Transactions</b>	<b>Change in Calculated Base Weight</b>
<b>Exclude Duplicate Transactions</b> Cardinal Health Distributor, Dec. 2007 (DEA: [REDACTED])	(610,381)	(1,747,195)
<b>Exclude Irrelevant Drug Codes</b>	(1,664)	(53)
<b>Exclude Erroneous Transactions</b> Action Indicator and Correction No.		
Both Populated	(59,223)	(69,513,829)
Adjustments to Previous Transactions	(483,885)	(26,215,303)
Deletions of Previous Transactions	(2,492)	(2,218,380)
Corrections of Previous Transactions	<u>(17,320)</u>	<u>(1,715,081)</u>
Total Erroneous Transactions	(562,920)	(99,662,593)
<b>Exclude Transactions Involving Reverse Distributors, Analytical Labs, Importers, Exporters or Researchers</b>	(45,398,192)	(1,083,219,607,303)
<b>Exclude Double-Reporting of Transactions between Registrants</b>	(14,508,254)	(8,671,652,671)
<b>Exclude Transactions with Obvious Errors in Quantity</b>	(1)	(34,053,752)
<b>Exclude Transaction Code "X" (Lost-in-Transit)</b>	(3,729)	(116,009)
<b>Fix Calculated Base Weight in Grams</b>	-	(183,394,936)
<b>Total Effect of Exclusions and Corrections</b>	<b>(61,085,141)</b>	<b>(1,092,210,234,512)</b>

### Appendix 3 Frequency and definition of transaction codes

Transaction Code	% of Transactions	Impact on Inventory	Description
S	88.43%	-	Sale, Disposition, or Transfer
Y	3.84%	-	Destroyed
Z	0.00%	-	Receipt by Government (seizures, samples, etc.)
Q	0.00%	-	Sampling (manufacturers only)
K	0.00%	-	Used in Preparations (manufacturers only)
N	0.00%	-	Nonrecoverable Waste (manufacturers only)
P	7.14%	+	Purchase or Receipt
R	0.55%	+	Return
V	0.03%	+	Unsolicited Return
G	0.00%	+	Government Supplied
L	0.00%	+	Reversing (manufacturers only)
M	0.00%	+	Manufactured (manufacturers only)
W	0.00%	+	Recovered Waste (manufacturers only)
J	0.00%	+	Return of Sample to Inventory (manufacturers only)
X	0.00%	n/a	Lost-in-Transit

## Appendix 4 Corrections to DEA's NDC Dictionary

<b>NDC</b>	<b>Ingredient Base Weight in Grams in NDC Dictionary</b>	<b>Corrected Ingredient Base Weight in Grams</b>
00603388228	136.215000	0.136215
00781560210	0.000892	4.460500
00056012770	0.000448	0.448300
00591245401	3,586.000000	3.586000
005913578**	0.000001	0.004500
107020184**	2.241250	0.002241
27280BH5701	0.570000	0.057000
52493019110	0.003020	0.030200
674330154**	0.000026	0.003027
674330888**	0.000705	0.021363
000440623**	0.000024	0.023900
00062A01628	0.695094	0.397197
00062A03228	0.695094	0.794394
000540438**	0.580400	290.200000

## Appendix 5 MME Conversion Factors (from CDC)

Opioid Oral Morphine Milligram Equivalent (MME) Conversion Factors<sup>1,2</sup>

<u>Type of Opioid (strength units)</u>	<u>MME Conversion Factor</u>
Buprenorphine film/tablet <sup>3</sup> (mg)	30
Buprenorphine patch <sup>4</sup> (mcg/hr)	12.6
Buprenorphine film (mcg)	0.03
Butorphanol (mg)	7
Codeine (mg)	0.15
Dihydrocodeine (mg)	0.25
Fentanyl buccal or SL tablets, or lozenge/troche <sup>5</sup> (mcg)	0.13
Fentanyl film or oral spray <sup>6</sup> (mcg)	0.18
Fentanyl nasal spray <sup>7</sup> (mcg)	0.16
Fentanyl patch <sup>8</sup> (mcg)	7.2
Hydrocodone (mg)	1
Hydromorphone (mg)	4
Levorphanol tartrate (mg)	11
Meperidine hydrochloride (mg)	0.1
Methadone <sup>9</sup> (mg)	3
>0, <= 20	4
>20, <=40	8
>40, <=60	10
>60	12
Morphine (mg)	1
Opium (mg)	1
Oxycodone (mg)	1.5
Oxymorphone (mg)	3
Pentazocine (mg)	0.37
Tapentadol <sup>10</sup> (mg)	0.4
Tramadol (mg)	0.1

<sup>1</sup> The MME conversion factor is intended only for analytic purposes where prescription data is used to calculate daily MME. It is to be used in the formula: Strength per Unit X (Number of Units/ Days Supply) X MME conversion factor = MME/Day. This value does not constitute clinical guidance or recommendations for converting patients from one form of opioid analgesic to another. Please consult the manufacturer's full prescribing information for such guidance. Use of this file for the purposes of any clinical decision-making warrants caution.

<sup>2</sup> National Center for Injury Prevention and Control. CDC compilation of benzodiazepines, muscle relaxants, stimulants, zolpidem, and opioid analgesics with oral morphine milligram equivalent conversion factors, 2016 version. Atlanta, GA: Centers for Disease Control and Prevention; 2016. Available at <https://www.cdc.gov/drugoverdose/media/>. For more information, send an email to Mbohm@cdc.gov.

<sup>3</sup> Buprenorphine formulations with a FDA approved indication for Medication Assisted Treatment (MAT) are excluded from Medicare's Overutilization Monitoring System's opioid overutilization reporting.

<sup>4</sup> The MME conversion factor for buprenorphine patches is based on the assumption that one milligram of parenteral buprenorphine is equivalent to 75 milligrams of oral morphine and that one patch delivers the dispensed micrograms per hour over a 24 hour day. Example: 5 ug/hr buprenorphine patch X 24 hrs = 120 ug/day buprenorphine = 0.12 mg/day = 9 mg/day oral MME. In other words, the conversion factor not accounting for days of use would be 9/5 or 1.8.

However, since the buprenorphine patch remains in place for 7 days, we have multiplied the conversion factor by 7 (1.8 X 7 = 12.6). In this example, MME/day for four 5 µg/hr buprenorphine patches dispensed for use over 28 days would work out as follows: Example: 5 ug/hr buprenorphine patch X (4 patches/28 days) X 12.6 = 9 MME/day. Please note that because this allowance has been made based on the typical dosage of one buprenorphine patch per 7 days, you should first change all Days Supply in your prescription data to follow this standard, i.e., Days Supply for buprenorphine patches= # of patches x 7.

<sup>5</sup> The MME conversion factor for fentanyl buccal tablets, sublingual tablets, and lozenges/troche is 0.13. This conversion factor should be multiplied by the number of micrograms in a given tablet or lozenge/troche.

<sup>6</sup> The MME conversion factor for fentanyl film and oral spray is 0.18. This reflects a 40% greater bioavailability for films compared to lozenges/tablets and 38% greater bioavailability for oral sprays compared to lozenges/tablets.

<sup>7</sup> The MME conversion factor for fentanyl nasal spray is 0.16, which reflects a 20% greater bioavailability for sprays compared to lozenges/tablets.

<sup>8</sup> The MME conversion factor for fentanyl patches is based on the assumption that one milligram of parenteral fentanyl is equivalent to 100 milligrams of oral morphine and that one patch delivers the dispensed micrograms per hour over a 24 hour day. Example: 25 ug/hr fentanyl patch X 24 hrs = 600 ug/day fentanyl = 60 mg/day oral morphine milligram equivalent.

In other words, the conversion factor not accounting for days of use would be 60/25 or 2.4.

However, since the fentanyl patch remains in place for 3 days, we have multiplied the conversion factor by 3 (2.4 X 3 = 7.2). In this example, MME/day for ten 25 µg/hr fentanyl patches dispensed for use over 30 days would work out as follows:

Example: 25 ug/hr fentanyl patch X (10 patches/30 days) X 7.2 = 60 MME/day. Please note that because this allowance has been made based on the typical dosage of one fentanyl patch per 3 days, you should first change all Days Supply in your prescription data to follow this standard, i.e., Days Supply for fentanyl patches= # of patches X 3.

<sup>9</sup> The CDC MME conversion factor to calculate morphine milligram equivalents is 3. CMS uses this conversion factor when analyzing Medicare population opioid use. CMS uses the graduated methadone MME conversion factors to calculate MME within the Overutilization Monitoring System (OMS) for identifying and reporting potential opioid overutilizers.

[https://www.cdc.gov/drugoverdose/pdf/calculating\\_total\\_daily\\_dose-a.pdf](https://www.cdc.gov/drugoverdose/pdf/calculating_total_daily_dose-a.pdf).

<sup>10</sup> Tapentadol is a mu receptor agonist and norepinephrine reuptake inhibitor. Oral MMEs are based on degree of mu-receptor agonist activity, but it is unknown if this drug is associated with overdose in the same dose-dependent manner as observed with medications that are solely mu receptor agonists

## **Appendix 6 ARCOS Summary**

176. Appendix 6A summarizes opioid shipment transactions reported in the ARCOS Data by drug, by reporter's business activity, by buyer's business activity, and by year for Cabell County and the City of Huntington, WV.

177. Appendix 6B summarizes opioid shipment transactions reported in the ARCOS Data by drug, by reporter's business activity, by buyer's business activity, and by year for West Virginia and all its counties

178. This appendix is attached as a separate 174-page PDF.

## **Appendix 7 Cabell County and the City of Huntington, WV Flagged Distributor Defendant Transaction Reports**

179. This appendix shows the result of implementing various methodologies described in Section VII to identify transactions meeting specified criteria using the non-public ARCOS Data from 2006 to 2014, supplemented with Defendant Transactional Data, of each Distributor Defendant.

180. This appendix is attached as a separate 218-page PDF.

## **Appendix 8 Map of Cabell County and the City of Huntington, WV**

181. This appendix includes a map illustrating the location of Cabell County (red) and the City of Huntington (yellow), along with the zip code 257\*\* and 255\*\* that covers the entire city and county.

182. This appendix is attached as a separate 2-page PDF.

**Appendix 9 Cabell County and the City of Huntington, WV**  
**Additional Expert Report Figures and Charts**

183. This appendix is described in Section VIII and attached as a separate 4,584-page PDF.

**Appendix 10 Other Exhibits**

184. This appendix is described in Section VIII and attached as a separate 2,528-page PDF.